AMERICAN DYESTUFF REPORTER

"Circulated Everywhere Dyestuffs Are Used"

Published by Howes Publishing Company, 440 Fourth Avenue, New York

Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

Volume XIX | SEPTEMBER 29, 1930 | Number 17

Mercerization and the Cellulose Micelle

By HERMAN BOXSER

THE triumph of chemical research in establishing a new industry, the manufacture of rayons—has encouraged investigations of the enigmatic source of this conquest, namely, cellulose. The result of these investigations has been the utilization of this primary raw material in other recent developments, as in the production of nitro-cellulose lacquers and pyroxylin products. However, there still exists a long-established product in the textile industry resulting from early researches upon the action of caustic alkali on cellulose. This is mercerized cotton.

With the ever-increasing data advanced by workers in the field of regenerated celluloses, much material has been gathered from these which is directly applicable to the theory of mercerization. This is especially true of investigations carried out in the viscose process, of which one of the earlier steps is the treatment of cellulose with alkali.

Whether mercerization is a chemical phenomenon or a purely physical state has been a source of much dissension and argumentation among workers in this field. However, since the advent of X-ray spectrophotography, considerable distance has been traversed in settling this perplexity.

The principal properties of cotton which has been subjected to mercerization are: (1) it retains more moisture; (2) it possesses a greater affinity for dyes (especially substantive dyes); (3) it is chemically more active and will hydrolyze more rapidly than native cellulose; (4) but it shows no marked chemical difference from the original cellulose[1].

With the above differentiation in properties of mercerized cellulose from the native cellulose in mind, it would be well at present to attempt to picture the structure of the former from X-ray data.

Cellulose may be considered as a two-phase system, that is, a crystal network with an amorphous mass. Clark[2] describes the native cellulose structure as composed of micelles, which are long, narrow bundles of primary valence chains of $C_6H_{10}O_5$ groups held together by oxygen linkages. Mark[3] further pictures this structure, by stating that these linkages are capable of being broken down by acids which would account for the tendering of the cotton fiber by mineral acids. The last named worker describes the secondary or residual valences possessed by cellulose. This force is created by the active hydroxyl groups which attract each other, thus causing the cohesion of the chains within the bundles or micelles. These hydroxyl groups may be replaced by nitro, acetyl, or alkyl groups, which would account for the chemical activity of cellulose.

Clark[4] from X-ray diffraction patterns observed that after cotton had been mercerized, there was no change in the direction parallel to the chains, but only in the sideways relations of the latter. These views have been substantiated by the X-ray data of Bragg[5]. Mark also maintains that by mercerization, there occurs a dis-orientation of the groups, producing a condition like irregular-placed bricks. In studying the micellar structure of cellulose, Fox[6] noted that mercerized cellulose displays a unit cell (micelle) which is shorter than that of unmercerized cellulose, along the fiber axis, which is coincidal with some of the conclusions of Clark. Fox even attempted to calculate the distention of the chains by mercerization, which he approximated as 45° half clock-wise and half counter clock-wise.

Due to this physical change, the chains are cast further apart, thereby creating a much greater internal surface. Blanco[7] assumed this, when he stated that "the hydration of cellulose (by mercerization) may be a condition of inter-molecular distention, whereby the surface reactions are largely increased and the absorptive property developed." The inner surface of mercerized cellulose has been approximated as double that of native cellulose. This would explain its greater chemical activity and also greater affinity for dyes. Due to this dis-orientation of the groups, we would also expect a difference in the behavior of the secondary valence forces of the mercerized cellulose, which has been found so.

In dyeing properties, mercerized cotton acts in a manner not unlike viscose rayon. Due to the variances in the mercerization processes, the mercerized fiber exhibits the tendency to produce light and dark skeins, when dyed with substantive dyes. This is especially true of light shades. These characteristics resemble to a great extent the dyeing properties of viscose. Like the latter fiber, mercerized cotton dyes much quicker than the "grey" yarn. Cotton, which has been mercerized, will dye most evenly with those dyes of the substantive class which are good rayon dyes, i.e., those which exhibit the least capillary crawl.

Sloan[8] advises the use of slowly exhausting colors which level well for the dyeing of mercerized yarns. We agree that dyes which level best are the proper ones to utilize, but those direct dyes which exhibit the greatest natural affinity for this fiber will yield good results if dyed quickly. However, since cotton yarns are dyed at a slower rate than rayons, and may be subjected to longer handling, it is the custom in the practical dyehouse to dye mercerized skeins slowly with the use of slower exhausting dyes which subsequently level out as the dyeing proceeds.

The similarity in the dyeing characteristics of mercerized cotton and viscose may be retraced to their resemblance in micellar structure. The micelles of both fibers exist in a dis-orientated state, although the disarrangement is not as pronounced in the mercerized fiber. In order for the dye micelles of a substantive dye solution to adhere by adsorption to the secondary valences of the mercerized cellulose, they must penetrate to a greater distance within the lattice work, due to the irregularity of the latter in this fiber. Therefore, there is greater penetration with the natural consequence of deeper dyeing.

The following table of Hall[9], describing the effect of tension during mercerization on the dyeing capacity of cotton would tend to support these assumptions. It will be observed that the dye absorption is less when the fiber is mercerized under tension. We should anticipate this, since by the application of tension the micelles are forced into a more parallel arrangement, resulting in the necessity of lesser penetration of the dye micelles in order to be adsorbed on the crystal lattice of the cellulose.

TABLE 1

	Absorption of Benzopurpurine 4B	
	Unbleached	Bleached
Unmercerized Cotton	1.55 per cent	1.50 per cent
Mercerized with Tension	2.90 per cent	2.86 per cent
Mercerized Without Tension	3.39 per cent	3.54 per cent

It appears that there is a better fixation of the dye micelles by the mercerized cotton, since tests by Haller and Ziersch[10] showed that the resistance to bleaching by sunlight of dyed mercerized cotton was approximately 15% greater than untreated cotton.

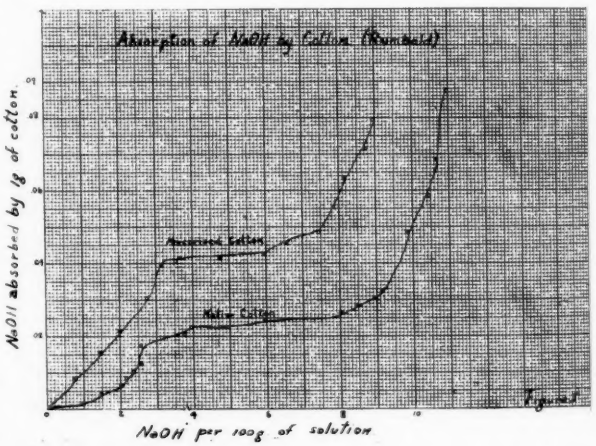
From comparing the dyeing properties of mercerized and native cellulose, there is little to suggest that there exists a different chemical compound in the former, as there is, for instance in acetylated cellulose. As it is well known, cellulose tri-acetate does not possess an affinity for the classes of dyes applicable to native cellulose.

It is apparent that X-ray spectrophotography has produced a well defined picture of mercerized cellulose. Yet, does it definitely answer the question, whether we have a chemical compound formed by the action of concentrated solutions of NaOH on cellulose? There may be four possible influences effected by this action:

(1) Swelling and hydration; (2) Adsorption; (3) Chemical Combination and (4) Degradation of the cellulose molecule.

Recent work studying the action of varying strengths of caustic soda in aqueous and alcoholic solutions on cellulose has shed some light on the above.

The minimum concentration of caustic soda solution which will produce mercerization has been found to be 8½%. The optimum concentration for the best mercerizing effect and production of the greatest affinity for dyes are from solutions of 23%-31% strengths. Rumbold[11] experimented with varying strengths of NaOH solutions on mercerized and unmercerized cotton, and found that the former had a greater power of absorption when subsequently treated with NaOH solutions. He noted that native cotton absorbed but little NaOH when subjected to solutions of a concentration under 5%. However, on increasing the concentration to 10%-11%, there was a considerable increase in absorption of NaOH, which grew with greater concentrations of alkali. These results are shown in Figure I. Rumbold, therefore, concluded that there was a chemical reaction by which one compound $(C_6H_{10}O_5)_{12}$. NaOH was formed for native cotton and another $(C_6H_{10}O_5)_{12}$. 2 NaOH for mercerized cotton.

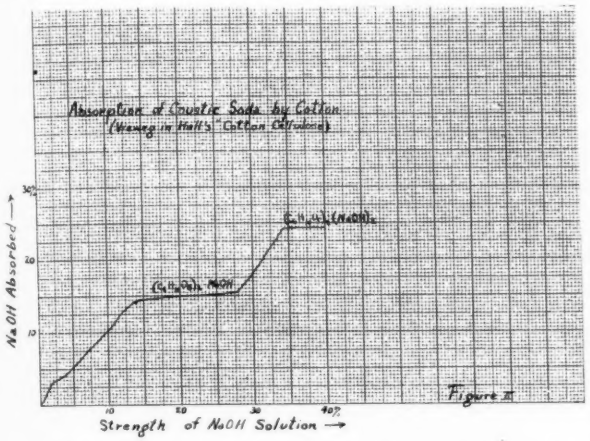


The fact that Rumbold noted that the maximum mercerization per given concentration of alkali occurred in such a rapid space of time (a few minutes) strengthened his belief that there was a chemical combination. Hall (ibid) observed the same action, but from his table below, it is apparent that there is a variance of the degree of mercerization during this short interval.

TABLE 2

Duration of Mercerizing	Shrinkage	Absorption of Benzopurpurine 4B
5 Seconds	15.7 per cent	3.24 per cent
10 Seconds	17.4 per cent	3.62 per cent
20 Seconds	25.0 per cent	3.80 per cent
40 Seconds	25.0 per cent	3.89 per cent
60 Seconds	25.0 per cent	3.91 per cent
180 Seconds	27.0 per cent	4.10 per cent

In describing Vieweg's work on the absorption of NaOH by cotton, Hall[12] reproduces the curve plotted by the former, who concluded that there was a formation of two compounds in mercerization—$(C_6H_{10}O_5)_2NaOH$ and $(C_6H_{10}O_5)_2$ $(NaOH)_2$. This curve is shown in Figure 2.



Chilikin[13] assumes that mercerization and adsorption of NaOH are distinctly two different phenomena. He bases his claims on the fact that they differ, in that in mercerization, the cellulose is subjected to a special preliminary preparation of boiling in alkali under pressure (boiling out). Cellulose treated in this manner would have a greater affinity for NaOH when subsequently mercerized. This view would be in accord with the results of Rumbold. Chilikin admits the possibility of the formation of a compound, 2 $C_6H_{10}O_5$. NaOH.

In a review of the literature on the action of alkalies on cellulose, Blanco (ibid) has shown that investigations indicate that the affinity of cellulose for NaOH is greater for higher concentrations of alkali with the ultimate formation of the compound $(C_6H_{10}O_5)_2$. NaOH between concentrations of 16%-24% NaOH solutions, and the compound $(C_6H_{10}O_5)_2$ $(NaOH)2$ with a 40% NaOH solution.

The formula $2C_6H_{10}O_5$ NaOH or $[Na(C_6H_{10}O_5)_2$ OH] has been favored by Rassow and Wolf[14].

Although cotton is not mercerized in a practical manner with alcoholic solutions of caustic soda, experimentations in this direction have been numerous. It appears that although the absorption of NaOH by cellulose is much greater from alcoholic than aqueous solutions, the swelling produced in the fiber is much less. Chilikin (ibid) observed that the maximum absorption of alkali occurred from a mixture of ethyl alcohol and water. Absorption from methyl alcohol-water mixtures was noted by Sharkov[15] to be less than the ethyl alcohol-water mixture. Blanco and Chilikin both agree that there is no chemical combination of NaOH and cellulose from alcoholic solutions, both describing this as a purely physical phenomenon.

The above observations tend to shed new light upon the action of alkali on cellulose, especially on the fact that concentrated solutions of the alkali must be used in order to obtain mercerization. Sharkov (ibid) found that if a 50% solution of methyl alcohol was used, but a 5% solution of KOH was required to saturate the cellulose, while with pure water, the maximum saturation was only reached with a 17%-20% KOH solution. The question, therefore, arises, "Why is so little alkali required to obtain saturation of the cellulose, in an alcoholic solution?" The answer seems to be, in the degree of ionization.

We know that (1) there is a greater degree of ionization of alkali in an aqueous than in an alcoholic solvent, and (2) that in an aqueous solvent, there is greater ionization of alkali in dilute than in concentrated solutions. It is a fact that there is least absorption of alkali and the minimum amount of mercerization where the ionization is greatest, i.e., in dilute solutions of 4%-5% concentrations. Therefore, mercerization must be dependent on the physical condition of the NaOH or KOH solution. It is apparent that when the molecular NaOH or KOH is increased by concentrating the alkali solution, maximum absorption of alkali and optimum mercerization is attained. An explanation for this may be as follows:

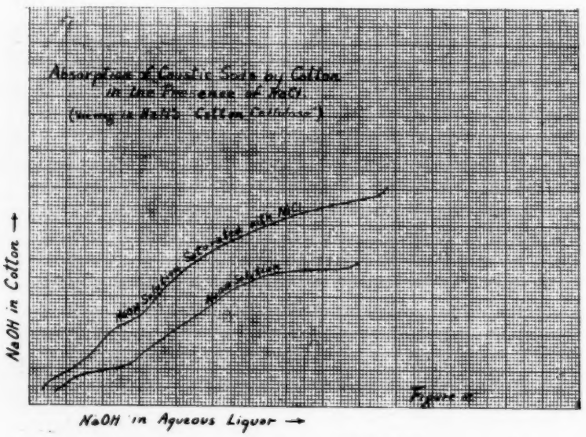
Simons[16], when discussing the dissolving action of neutral salts on cellulose, cited Williams[17] who claimed that in order for a neutral salt solution to dissolve cellulose, it must consist of a liquid hydrate—an associated molecular complex of salt and water. Further observations of these associated molecular complexes were made by Washburn[18] who, in attempting to calculate the molecular weights of liquids, noted regular abnormalities of certain solutions, and he ascribed these to the molecular association of certain substances when in solution. In fact, he described water as an associated liquid, i.e., consisting of H_2O, $(H_2O)_2$ and $(H_2O)_3$, the last two being named di-hydrol and tri-hydrol, respectively.

Such a condition of association may be present in concentrated NaOH solutions. Thus, we might understand this state—the slight agglomeration of NaOH molecules—as the first step towards the formation of a colloid.

In describing the direct dyeing of cellulose, Myer (ibid) asserted that the dye particles must possess sufficient size to enable them to adhere to the secondary valences of the fiber. We know that dyes which exist as true solutions are not adsorbed by cotton with reasonable fastness. Analogously, it is also evident that NaOH is not adsorbed from dilute solutions to any great extent. But, it is a fact that excellent adsorption occurs from concentrated solutions where ionization is small and the possibility of

molecular association great. Referring back to Myer's above assumptions, may it not be an instance where particles are present possessing sufficient size, by the formation of associated molecular complexes, to enable them to adhere to secondary valences?

It is interesting to note that greater adsorption of NaOH takes place when a neutral salt is added to the alkali solution, a phenomenon which happens in direct dyeing. Curves illustrating this are shown in Figure 3.



Assuming that the association of NaOH occurs in mercerizing liquors, accentuation of this physical condition would likely be produced by a neutral salt with subsequent greater adsorption.

Neale[19] studied the action of NaOH in cellulose, and concluded that the swelling of the fiber was due to osmotic forces. Although Neale admitted the formation of a sodium salt of cellulose, he claimed that the salt hydrolyzed on washing after mercerization. It was his opinion that following this hydrolization, the cellulose was recovered unchanged chemically, but physically distorted.

In the foregoing, we have attempted to relate some of the most recent work accomplished in investigating the action of caustic alkali on cellulose. Similar to many other phenomena in which one (fiber) of the substances present is a colloid, mercerization is a process from which a product results, which we cannot truthfully describe chemically. Many have assumed that due to the rapid absorption of NaOH from concentrated solutions, there is a formation of a chemical compound, the formula of which still remains in doubt. A résumé of observations resulting from X-ray research shows that there is a penetration within the cellulose micelles by the caustic alkali, without any chemical inter-reaction. According to the X-ray, mercerization is purely a physical change, in which there occurs a rearrangement of cellulose micelles and a possible production of a greater number of these.

Mercerized cotton has existed in textile industries since the middle of the nineteenth century. It has only been within recent years, with the production of rayons and the new utilizations of cellulose products, that great strides have been made in seeking the true action of caustic alkalies on cellulose with the ultimate purpose of answering the question, "Does mercerization produce a chemical or physical change in cellulose?" To date, there has not been an agreement of opinion on this interrogation. Yet, a settlement of the latter does not appear distant.

LITERATURE CITED

[1] Wise (Cellulose 1, 3, 1930).
[2] Clark (American Dyestuff Reporter 19, 2, 1930).
[3] Mark (Melliand 1, 1, 1929).
[4] Clark (Ind. and Eng. Chem 22, 5, 1930).
[5] Bragg (Cellulose 1, 4, 1930).
[6] Fox (Jour. Soc. Chem. Ind. 49, 83, 1930).
[7] Blanco (Ind. and Eng. Chem. 20, 926, 1928).
[8] Sloan (American Dyestuff Reporter 18, 473, 1929).
[9] Hall's "Cotton Cellulose" p. 76 (1924).
[10] Haller and Ziersch (Chem. Abstracts, 24, 2606, 1930).
[11] Rumbold (Jour. Amer. Chem. Soc. 52, 3, 1930).
[12] Hall's "Cotton Cellulose" p. 81 (1924).
[13] Chilikin (Chem. Abstracts 24, 1972, 1930).
[14] Rassow and Wolf (Chem. Abstracts 24, 1737, 1930).
[15] Sharkov (Chem. Abstracts 24, 956, 1930).
[16] Simons (Cellulose 1, 4, 1930).
[17] Williams (Jour. Soc. Chem. Ind. 40, 221, 1921).
[18] Washburn (Principles of Physical Chemistry, p. 60, 1921).
[19] Neale (Chem. Abstracts 24, 3111, 1930).

Southern Textile Exposition, Greenville, S. C.

It is expected that the ninth Southern Textile Exposition which opens in Textile Hall next month will bring 20,000 textile executives, overseers, section men and skilled operatives to Greenville. About two hundred exhibitors will display their latest products. There will be modern machinery of every kind.

The bleaching and finishing of cotton goods which is now such an important part of Southern industry will be given marked attention by a number of exhibitors. Chemistry and dyeing will also figure prominently in the displays.

The Southern Textile Association will hold its annual autumn convention on Friday, October 24th. The program is as follows:

11 A. M. to 12:30 P. M.

Convention S. T. A. ballroom, Poinsett Hotel. Presiding officer, President J. O. Corn.

Address—Geo. S. Harris, Hunter Manufacturing & Commission Co., New York City.

Address—C. K. Everett, The Cotton Textile Institute, Inc., New York City.

1:00 P. M.

Luncheon—Main dining room, Poinsett Hotel. Presiding officer, Edwin Howard.

Introduction of distinguished guests.

Address—Dr. H. E. Rondthaler, president Salem College, Winston-Salem, N. C.

10:00 P. M.

Dance—Informal. Ballroom, Poinsett Hotel. Complimentary to members of Association.

A distinguished speaker of national reputation will also address the textile section of the American Society of Mechanical Engineers which holds its convention Wednesday, October 22nd.

Other important technical meetings will be held during the week. Everything is being put in readiness for one of the most interesting expositions ever held.

Advances in the Dyeing of Artificial Silk

By **DR. H. G. BODENBENDER**

Translation by F. S. Beattie

ARTIFICIAL silk is to-day no novelty to the dyer. The enormous production and consumption of recent years has forced him to reckon with the special properties of the new textile. Artificial silk, once in the position of a helpless child, to be treated tenderly, has now become a welcome guest in the dyehouse, and even now it has perhaps reached only an intermediate point in the interest which it excites. The industry is being continuously forced to extend further the boundaries of the field of artificial silk dyeing, through working out of new dyestuffs and finishing agents, that the valuable properties of the material may be most fully taken advantage of.

The firms which produce artificial silk have also directed their special attention to this field, for we have learned to perceive that many difficulties which have arisen in the dyeing of artificial silk in yarn or weave owe their origin, not to the dyeing process itself, but to the process of manufacture or the mode of working up of the fiber itself. Accordingly, in recent years the manufacturer has directed his efforts more and more toward avoiding defects and sources of trouble in dyeing, whose cause is located in the fiber itself. At first, the makers directed their efforts mostly or wholly to quantitative production; but the steady development of the industry during the past ten years has given time and opportunity to the giving of special attention to the problems of improvement in quality.

It has for a good while been recognized that variations in the titer are capable of causing variations in dyeing. Artificial silks of 150 deniers, with perhaps 25 individual filaments, dye in a way which differs from that of a 150 denier, 35 filament fiber. Dyed in the same bath, the fiber of a greater number of elements come out with a lighter shade than does the other. This difference in the filament count of the fiber may have (and, if the fiber was supposed to be of the same lot, would have) originated in the accidental plugging-up of some of the perforations in the spinneret, so that a particular spinneret was generating a false-count fiber. Such a cause of variation in what is supposed to be a uniform fiber has put the manufacturer on his guard against this one source of later trouble, for example, and by careful oversight and replacement of the plugged-up spinneret, and by a more careful filtration of the viscose solution before spinning, this unevenness in composition of the fiber is done away with.

Another source of trouble is unevenness in dyeing, through no fault of the dyer, and is caused by a particular artificial silk suffering excessive stretching in either its manufacture or working up. Since the artificial fiber is less elastic than natural silk, it will, if over-stretched, remain to some extent in that condition, and then will dye unevenly. Special care in reeling and spooling, as well as the employment of properly-constructed machinery, makes it possible to reduce this trouble to a minimum.

There are other sources of trouble, too, originating in the manufacture of the fiber, and which show up only when the material comes to be dyed, sources of trouble which we have learned to avoid. Thus, in these days, it can hardly be the case, that different sorts of artificial silk would be worked up into the same lot, in either weaving or working up further, as actually was the case not so long ago. Such mixed material naturally led to decidedly faulty dyeings. The manufacturer knows now that for one lot he must work up artificial silk of only one origin. Since the different manufacturers of the artificial fibers employ partially distinctive procedures in the synthesis of the fiber, and even the slightest variations in it bring about a differing affinity for dyestuffs, the dyeing together of different grades, even, of artificial silk could easily cause unevenness in results.

Through the co-operation of the different workers in the artificial silk field, from the manufacturer of the fiber through to the consumer of the finished goods, it has been found possible to do away with a great number of the difficulties which in earlier years had led to the so much dreaded complaints, demands for replacement of damaged goods, and law suits.

Of the various kinds of artificial silk, viscose, now as at first, has maintained its dominant position, and its production amounts to 84% of the total world-production. Its behavior toward dyestuffs, which rather resembles that of cotton, as well as its special mode of treatment in dyeing, is so well known that this matter does not need comment.

A behavior toward dyestuffs, similar to that of viscose, is displayed by two new kinds of fiber, which in recent years have found their own place in the market. They are the Celta silk of Elberfeldt, and Vistra silk of the I. G. As is well known, the Celta, or air-silk, is composed of a fiber which contains an internal air-filled space; and through its unusual superficial structure it possesses a specially soft, full character, and a matte, silk-like luster. Celta silk also possesses special heat-insulating properties, because of its internal air-spaces. Since the fiber is chemically identical with viscose, from which it

differs only physically, the dyeing of it offers no difficulties, and is carried out exactly as for viscose. But it must at this point be remarked that the fiber undergoes a finishing treatment, so that the vats or tubs used for dyeing must not have any rough, slivered spots, which could lead to catching and breaking of the individual filaments, for these possess a more roughened, scaly surface than viscose silk, due to their method of formation (this peculiar surface is what accounts for the dull luster). As in the case of viscose, we must note the circumstance that artificial silks in the wet state lose more tensile strength than do other textile fibers, and too great demands along that line must not be made upon them.

Vistra is an artificial spun fiber, which is synthesized similarly to viscose silk (unripened viscose is mostly used for it); the filament is then cut into any desired staple length, and spun like cotton, into yarn. The method of dyeing this fiber, as well as the weaves produced from it, is similar to that for viscose yarn. It is to be noticed in this connection that Vistra yarn possesses a specially high affinity for the different dyestuffs, which makes it in many cases necessary to slow down the taking up of the dyestuffs through suitable additions to the bath.

The dyestuffs of the leading manufacturers, which serve for the dyeing of viscose, and pass under the most varied names in trade, and which can be studied on the firms' sample cards, have most recently been widened in scope by a number of new shades. This is especially true for the very light-fast substantive dyestuffs for viscose silk, which go by the name of the Sirius colors (of the I. G.). Among these dyestuffs, the brands which level reasonably well, and which are suited for the dyeing of such viscose silks as are inclined to dye unevenly, have been specially so designated.

In reference to the suitability of dyestuffs for viscose silk, the firm of Courtaulds' has published a rapid means of testing for this point. The viscose is first treated with caustic soda solution, which increases its affinity for dyestuffs. If, in the same bath, such a pretreated strand is dyed in parallel with an untreated one, only a slight difference in shade will be evident, in the case of dyestuffs or mixtures thereof which are well suited for the material. But if one strand dyes much differently from the other, then the dyestuff used is unsuitable, and it is best to replace it by some other one. The same firm gives a procedure for improving viscose-silk dyed unevenly with substantive dyestuffs, consisting in subjecting the goods to an after-treatment in a bath containing beta-naphthol and common salt.

The I. G. publishes a sample card on which, among their Sirius colors, those are specially indicated which in general stand the brightening bath well. These dyestuffs, after dyeing, are brightened in an after-bath of 5 g. of lactic acid to the liter.

Since the number of tones and shades in which artificial silk can be dyed is continually growing, the circles interested in them have begun to announce selected colors in various standard shades. For example, a Chemnitz firm has this year put out a card of mode dyeings for hosiery, which covers 36 dyestuffs for artificial silk hosiery, in 12 divisions: silver, stone, metal, mode-pink, erica, new mode, beige, sand, clover, autumn, pink, and umbra.

Matte Artificial Silks

Changes in fashion have frequently excited the desire to decrease the glassy, often very spotty, high luster of viscose silk, and even to give it a matte surface, in order to increase its resemblance to natural silk. In following out this tendency, while the producers of the fiber are striving to bring upon the market a product already matte-surfaced, dyers seem to prefer to take the material in its highly lustrous state and deluster it themselves, either before or after dyeing. The process of delustering, as it is most generally called, consists essentially in precipitating upon the surface of the fiber insoluble compounds of either inorganic or organic nature. Most commonly, the material is impregnated with a bath of barium chloride (5-10 g. per liter), centrifuged, and treated in a fresh bath with Glauber salt, 5-15 g. per liter. Barium sulphate is thus precipitated upon the fiber, and dulls the luster considerably. Instead of precipitating the sulphate in this way upon the fiber, it can also be applied in solid form as the pigment, Blanc Fixé, by treating the fiber for a short time, at an elevated temperature, with a suspension of the pigment. Such a delustering agent is easily removed on washing the material. An effect fast to washing can be obtained by using, instead of the above, a first bath of sodium stannate (2-5 g. per liter), and a second bath of barium chloride, as above. There are also various special preparations marketed for the purpose.

Dyeing of Cupro (Bemberg) Silk

Cupro silk is, like viscose and nitro silks, a regenerated cellulose (in contrast to natural cellulose and cellulose derivatives, such as acetate silk). Because of its more circular cross-section, it possesses an affinity for dyestuffs which distinguishes it from all other synthetic fibers; it possesses the highest affinity for dyestuffs of any of them. It also takes up the dyestuff much more strongly and rapidly than does cotton, a fact which becomes strikingly evident when mixtures of the two fibers are dyed. In order to secure level dyeings upon cupro silk with substantive dyestuffs, one has to see to it that the absorption of the dyestuff takes place as slowly as possible, which can be accomplished easily by addition of soap or ammonia water to the bath, as well as by a slow increase of bath temperature. Through the work of Courtaulds, Weltzien, and Whitaker we recognize the dependence of the different kinds of artificial silk upon the temperature of dyeing; for cupro silk it is necessary to enter it cold and to raise the temperature slowly to 50°-70° C. For basic dyestuffs cupro silk has a slighter affinity than have viscose and nitro silks. It is, therefore, necessary always to mordant it for light tones, otherwise the dyeings obtained are too likely to come out turbid. Most of the basic dyestuffs which may be used can be substantially improved by various after-treatments.

Dyeing of Acetate Silk

The unique position of acetate silk, in view of its chemical composition as a cellulose derivative (through which fact most direct cotton dyestuffs are not suited for it) is nowadays taken advantage of through use of special methods and special dyestuffs, the latter of which can be divided into three groups: suspensoid, water-soluble, and developer dyestuffs; one or the other of which permit any desired tone to be obtained.

The older method, that of superficially saponifying acetate silk and then dyeing with direct cotton dyestuffs, as with regenerated cellulose, is now abandoned. The theory of acetate silk dyeing has of recent years been enriched through the studies of Kartaschoff and Farine, and of H. Brandenburger. The (German) dyestuffs mostly used, of the suspensoid group, are the Cellitone and Cellitone Fast dyestuffs, which occur in the market usually as pastes. These are I. G. products. Setacyl Direct dyestuffs are offered by Geigy, Cibazet dyestuffs by the Gesellschaft fuer Chemische Industrie in Basle, and Artisil Direct dyestuffs by Sandoz. The water-soluble dyestuffs of the I. G. go under the name of the Cellite and Cellite Fast products. The same firm markets the Cellite Azols for use as ice colors.

Since acetate silk possesses an acid character, it shows toward basic dyestuffs such affinity that light tones cannot be dyed without special additions to the bath, in most cases. In this field, of acetate silk dyeing, a large number of new patents have been applied for and granted, whose scope extends beyond acetate silk to the cellulose ethers and their derivatives. How far these dyestuffs may evolve into commercially available products only the future can tell, so that they need not be specially mentioned here.

On account of its characteristic properties, acetate silk in garments must be handled for dyeing differently from other artificial silks and textiles. It is to be noted that in dry-cleansing such materials, for example, acetone, amyl acetate, and most chlorinated hydrocrabons attack or dissolve the acetate silk (its solubility in acetone is a convenient test for its recognition). The garment dyer must, therefore, test for its presence, and also test his cleansing agents as suitable for the material. Benzene-free benzine and alcohol are the best cleansing agents for it.

Dyeing of Mixed Weaves

a—Artificial silk with cotton—The synthetic fibers are finding increased use in combination with other natural fibers, and accordingly, through careful choice of dyestuffs, the most manifold effects can be obtained. First in importance among these mixed weaves are the goods consisting of cotton and the regenerated celluloses, viscose, cupro, and nitro silks. In dyeing, care has to be taken that the synthetic elements of the weave do not take up the dyestuff too rapidly, on account of the danger of unevenness in the dyeing. Then, too, the cotton will behave differently, according to its quality and origin, whether mercerized or unmercerized, etc. The difficulties are greatest with mixtures containing cupro silk, since this fiber, as already mentioned, possesses a very strong affinity for dyestuffs, and so, in dyeing the same tone for each weave-element, the artificial fiber comes out dyed much more deeply than the cotton. Lighter tones can be much more easily obtained in these mixtures. As to detailed information about dyestuffs, and methods, the literature of the dyestuff firms has to be consulted.

b—Artificial silk with wool—This sort of union goods is also coming to the fore in recent years; in fact, very recently a corporation has been formed for manufacturing a fiber, similar to Vistra, for working up alone or in combination with wool. In dyeing such mixtures, we proceed either by the one-bath method, using half-wool dyestuffs with Glauber salt, or by the two-bath method, in which the wool is dyed with acid wool dyestuffs, and the goods after rinsing, dyed, as to the artificial silk, with suitable direct colors, again with Glauber salt. Some weaves can, of course, be distinctively dyed, by employing only suitable wool dyestuffs, which leave the artificial silk untouched.

c—Artificial silk with natural silk—Much the same is true of this sort of goods as of the preceding weaves.

d—Acetate silk with natural silk—Because of the characteristic behavior of acetate silk, it is easily possible to produce effect-fibers of the most varied sort, through which the beauty and value of the weave are increased. Acetate silk takes up very little indeed of most of the ordinary dyestuffs, and conversely, dyestuffs suited for acetate silk color natural silk (as well as other fibers) only very slightly. We can, for example, dye a ground of natural silk, and leave the acetate silk untouched, and conversely, dye the acetate silk in all possible tones, while leaving the silk untouched.

e—Acetate silk with cotton—The same manifold possibilities exist in this case also, depending upon whether we dye in a compound bath for each fiber, or with acetate silk dyestuffs alone, or with direct cotton dyestuffs alone. So many possibilities exist in all the cases mentioned, that it is impossible to do more than merely remind the reader of their existence.—*Der Textil-Chemiker u. Colorist* 11, 73, 1930.

Textile Evening Trade School

The Textile Evening Trade School at 124 West 30th Street, New York City, is again offering the course in Textile Chemistry. The course includes: identification of the common textile fibers, distinguishing the various rayons, the general and special processes applied to the fibers and the principles involved in scouring, bleaching, mercerizing, finishing, weighting, fireproofing, etc. The course also includes a discussion of fastness tests and general methods of identifying dyestuffs.

H. H. Willis recently resigned his position as Senior Cotton Technologist of the U. S. Department of Agriculture in order to devote his full time to directing the textile department of Clemson College, North Carolina.

The Use of Antiseptic Agents for the Prevention of Mildew

By **L. L. LLOYD, Ph.D., F.I.C.**

ORGANISMS, if allowed to develop in fabrics, often cause defects such as tendering, color alteration, or the formation of color by the products of the growth of the organisms. In some cases these faults cannot be remedied and consequently may be a source of financial loss. For the development of organisms in textile materials, water or moisture is essential, and since mildew-producing organisms will develop with a slight increase in the moisture content, these are the common sources of damage. Bacterial damage requires a larger content of water in the material in order to allow of the development of bacteria; this type of damage develops on goods which have been left to stand in a wet condition or have become soaked with water so that this cannot readily and quietly evaporate.

Fungal Growths on Cotton

With cotton and linen goods fungal growth is the chief source of trouble, and in many of these cases the material may be damaged by color spots or blotches without being tendered and may often be treated to obtain a satisfactory fabric again. These defects sometimes begin when the material is in the finishers' sheds or in the packing warehouses, but they more commonly occur during transit by ship, etc. The goods if finished with their full amount of condition moisture, may be stored during conveyance from one part of the earth to another in a warm hold of a ship where the heat will drive the moisture from the hottest part to the coolest and thus increase the moisture content in the cool area to such an extent that either bacterial or fungal growths or both readily develop.

The goods that are most prone to these defects are those filled with starches, glue, casein, soaps, soluble oils and glycerine. These agents furnish a readily available food substance sufficient in amount to allow of mould fungi being produced before the fibers themselves are attacked, but in other cases where the foodstuff is not present the fibers themselves will be attacked and tendered.

Cloths That Suffer Severely

Among the cloths which suffer severely are those that are slop-filled with glue or with casein. Goods of this type such as Jeans or Dungarees are usually filled in an alkaline condition which greatly aids mildew development. As a rule these goods are not filled with preparations that inhibit the growth of moulds and consequently when transported in too moist a condition or when wetted by sea water, they arrive with mould growths of all colors and possess a musty odor. The small amounts of soap, whether it be hard or soft soap, also aid the formation of mildew, and since cotton goods are often scoured and mildly washed they usually retain small amounts of soap.

Oleines Aid Mildew Growth

Soluble oils, termed oleines in Lancashire, also aid mildew growth. These agents are often used in the filling preparations to obtain a reasonably soft handle, and when used along with starches there is usually a small amount of phenol added to prevent liquefaction of the starches. The amount employed, however, is too small to prevent mildew growth and further, phenol is too volatile to remain in the cloth. In some filling preparations vegetable oils are also added to induce softness of handle and pliability. These oils are also subject to mildew growth, whereas mineral oils that would not favor fungi and would give pliability are not employed.

In many cases damaged cloths may be put to rights by thoroughly scouring and re-finishing them. This applies particularly to the so-called sea-water damage, provided that the cloth has not remained in the brine for a period sufficiently long to allow bacterial growth to cause tendering.

Repairing Damaged Fabrics

The writer has examined many fabrics which were not tendered, but were covered with blotches of mildew that were readily removed by well soaping the cloth and then treating it for a short period with very dilute hypochlorite solution. These fabrics were mainly indigo dyed and filled either with glue and starch or with casein dissolved in alkali. In no case has the filling preparation contained formaldehyde, which, besides making them less liable to attack by moulds would also render the glue and the casein insoluble in water, so that they would be more permanent in the cloth and not removable the first time that the material was washed.

It is necessary in most filled goods to use some softening agent to give pliability to the material and for this purpose soluble oils, Prestabit oil, or Avirol should be added to the filling preparation, but in order to minimize the danger of mildew formation, some antiseptic agent should be added.

Among the fungi, *aspergillus niger,* better known as black mould because it is probably the commonest of the fungi that produce nigger brown to black deposits, is perhaps the most troublesome because it is so difficult to

remove from material when developed to more than a small amount. Phenolic bodies, even in small amounts, prevent it from developing, but most of these are too readily volatilize from fabrics. Ortho cresol is a stronger antiseptic than phenol and it has been shown that, generally speaking, the greater the molecular weight of the ortho substituting group the greater is the antiseptic power. Salol, or phenyl salicylate, or better still, naphthyl salicylate are useful agents for this purpose but probably the body of most general efficiency is the anilide of salicylic acid or better still the naphthalide of this acid (See The Dyer, Feb. 15, 1930, p. 215). These bodies may be incorporated in the filling preparations (together with a little soluble oil or other softening agent to give pliability) in order to reduce the risk of mildew development to a minimum.

Preventing Mildew Growth

Bacteria and fungi are always present in the atmosphere and consequently textile fabrics during production, finishing, warehousing, etc., are always open to receive them. It is no use attempting to destroy them, but means of inhibiting or preventing their growth should receive attention. In the first place, it should be remembered that the prime cause of mildew depends upon the amount of water present in the material. The amount of moisture present in a textile fiber that has been conditioned in an atmosphere of 70 per cent relative humidity, that is the amount conditioned to standard regain, is considerably below the minimum necessary for mould growth. It requires, however, but a slight variation of temperature to cause condensation of moisture to take place, or to cause the moisture of one portion of a bale of cloth to wander to another, and this will then give the necessary moisture content to allow the fungi to develop.

If means of ventilation were provided then the possibility of mildew growth would be practically nil. This, however, would probably lead to deficient weight in the material. It is on this account, especially in summer, when goods are stored in cold buildings, often with concrete floors, that antiseptic agents should be employed. Wherever goods or raw material is stored, efficient ventilation will prevent mildew development. Raw material, yarn or piece goods should not be placed on the floor but should be raised a few inches from it and even with trays, unless the air of the room be kept constantly in motion by means of fans, mildew growth may take place.

Alkali and soap favor mildew growth and even in unfilled textile materials there is always the possibility of small amounts of these agents being present. The customary practice of despatching goods in air-tight cases is much to be deprecated, because the stagnant conditions so produced permits the growth of fungi by localized alterations in the moisture content. This applies to nearly all textile materials, because moist goods are sold by weight, as well as by length and breadth, and consequently they are usually shipped fully conditioned. It would be better and safer, however, if arrangements could be made whereby goods for transport were packed in as dry a condition as possible and then allowances made for the regain that would take place when these goods were unpacked and again conditioned by the moisture of the atmosphere.

This applies to almost every type of textile production. A good example of the above may be taken from the carpet industry. The writer has examined many carpets produced in Britain that have been shipped and have arrived at their destination practically ruined through the growth of mildew. These goods were in each case fully conditioned before packing. Indian woven carpets, however, whether finished or in an unfinished state, are packed in as dry a condition as possible for shipment and consequently it is only very rarely indeed that one meets with damage to them due to mildew. The various chambers of commerce throughout the world could, no doubt, deal with matters of this kind in an effort to minimize the financial loss caused by mildew. — *Dyer & Calico Printer.*

Communication

The Elimination of Warp Streaks from Rayon Piece Goods

By Jerome D. Chaky
Gotham Piece Dye Works

A NUMBER of articles of merit have recently been written concerning the elimination of warp streaks from rayon fabrics, especially Viscose and Tubize. In the July number of the American Dyestuff Reporter, H. Boxser states that, as a rule, the more colloidal substantive dyes exhibit much greater affinity for cotton and rayon when applied without the addition of electrolytes, in most instances at a boiling temperature.

I must concede that this procedure works out favorably as a rule, but the queston is, what can a dyer do in cases where the streaks are so persistent that even the above-mentioned process will not eliminate them. We all understand the troubles and hardships of the dyer and chemist. I have had some of them myself, especially those in which the fault lies within the fiber itself. With the present competition in the dyeing industry one really cannot tell his customers the fact, it would not do him any good. They want the dyeing done right at the lowest cost, and that is where the story ends. Therefore, the only way out for the chemist is to devise some means whereby he can overcome the difficulty in the quickest and most economical way.

I have done considerable experimenting myself with streaks of the more persistent type. The experiments were confined to all rayon twills, dyed on the jig, because this combination gave the most trouble. Brilliant Sky Blue G, 5G, R, 2RM (G.D.C.) when dyed with the addition of Glauber's salt in a bath acidified with acetic acid produce better results than any other

Sky Blues that I happen to know of. Of these three colors, the 2RM is the best as far as the elimination of warp streaks is concerned. The Sky Blue R and 2RM give very reddish shades of blue and the G and 5G are much greener, similar to Sky Blue 6B.

However, their greatest drawback is the lack of fastness to light and alkalis. They simply cannot stand washing, but they have an excellent brightness nearing that of the basic blues, and are very easily applied. One cannot help but think that the pH is a factor of some importance, but we have tried varying it in the dyeing of a number of colors and found it to have no effect.

When dyed in a neutral liquor on union goods such as hosiery, certain acid colors have a tendency to stain cotton to a greater extent than is expected, and they have the same property when dyed on rayon fabrics in a liquor acidified with acetic acid plus Glauber's salt. Some of these colors seem to eliminate the streaks to a greater extent even than the others previously mentioned. They possess good fastness to light, but are not fast to washing. The dyes I have tried for this purpose are the Polar colors.

We scoured 200 yards of rayon twills (Tubize) for each experiment on the individual dyestuffs to be tested, and also for a few compound shades, all of the type in which the streaks could not be eliminated in any way. After scouring and rinsing them thoroughly, they were dyed with Polar colors with the addition of Glauber's salt and acetic acid at 190°F., rinsed in cold water and shelled up. The amount of liquor in the jig was half or one-third its capacity in order to economize, if possible, and because of the poor exhaustibility.

The dyes that appear to produce the best results among the Polar colors so far tried, are Polar Blue F conc., Polar Orange R and GS, Polar Red G, R, RS conc. and Polar Violet RC. In most cases the streaks were eliminated altogether or to a much greater extent than in any other way. For shading purposes any good substantive color can be used that will answer the purpose and can be used in the same bath with the acid dyes. For instance, the Flavines (Direct Flavine S, N.A.C.).

The Polar colors have a very good fastness to light and washing on the animal fibers, and in view of this fact were selected for the experiment. It is quite logical that one could not expect them to retain their fastness properties on rayon, but to light they are as fast as some of the substantive dyes. The worst setback lies in their lack of fastness to washing. A mordanting process with tannic acid fixed with tartar emetic improves them somewhat but not sufficient to justify the time and expense. It is possible to precipitate them to form a color lake but in my opinion this is liable to change the shade, although it may improve the fastness to washing somewhat.

Concerning the exhaustibility, it is observed that the oranges and the violets exhaust fairly well, the blues not as well in this respect. They can be used for light and medium shades, but are unsuitable in dark shades.

Reviewing the whole experiment it seems rather remarkable that certain acid colors, not intended for rayon dyeing at all, should eliminate warp streaks from Tubize rayon. It is certain that there must be a reason for this and we have a number of theories regarding this factor, but it would be folly to state them without a check-up of some kind, for which the writer is not equipped. When the true factors that play a part in this are determined, it is probable that some dyestuff may be produced that incorporates the same properties and possess the required fastness to washing at the same time, or some way may be found to improve the fastness of the present dyes.

I wish to make it clear that I am not recommending the dyeing of rayon goods with acid colors. I am only trying to state the results of an experiment. I advocate the use of specially selected substantive dyes as described often in all papers; dyeing them in the slowest possible way and adding the dye solutions in small portions with the omission of salts at high temperatures. It may be that some times no washing fastness is required at all on certain goods, then there is time enough left to think about the acid dyeing process.

In closing, I feel that I should mention the fact that there may be other dyes besides the Polar colors that will answer the purpose and completely eliminate streaks from Tubize and other rayons, but to be frank I have been more familiar with these dyes, therefore my experiments were confined to this group and to substantive dyes.

Sulfogene Carbon 4G Grains

The dyestuffs department of E. I. du Pont de Nemours & Company has recently placed on the market Sulfogene Carbon 4G Grains, which produces greenish shades of black.

This product is said to be very soluble, non-dusting, disperses readily and wets out easily in water, so that the difficulty encountered from floating on the surface is entirely eliminated. Because of its physical form, Sulfogene Carbon 4G Grains is more stable than the powder brands, storage being possible for longer periods without deterioration than with the regular forms of sulfur black.

It is stated that by the special selection of intermediates and careful chemical control, the copper content has been so carefully controlled that Sulfogene Carbon 4G Grains is suitable for application on all type of cotton materials that are to be rubberized. In addition, this new dyestuff is claimed to possess all the excellent fastness and dyeing properties exhibited by the company's other Sulfogene carbons.

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

President
E. H. KILLHEFFER
Newport Chemical Works, Passaic, N. J.

Vice-Presidents
WALTER S. WILLIAMS—P. J. WOOD

Treasurer
HARRY R. DAVIES

Secretary
ALEX MORRISON
American Woolen Co., Andover, Mass.

Councilors
RALPH F. CULVER — GEORGE A. MORAN
B. F. PHETTEPLACE — HUGH CHRISTISON
WILLIAM R. MOORHOUSE — WALTER M. SCOTT

Past President and Chairman of the Research Committee
LOUIS A. OLNEY
Lowell Textile Institute, Lowell, Mass.

LOCAL SECTIONS AND THEIR OFFICERS

Northern New England Section—
Henry D. Grimes, Chairman, Washington Mills, Lawrence, Mass.
Harold C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Rhode Island Section—
Richard B. Earle, Chairman, 133 Power St., Providence, R. I.
A. Newton Graves, Secretary, Franklin Process Co., Providence, R. I.

New York Section—
Robert H. Gaede, Chairman, Gaede Silk Dyeing Co., Paterson, N. J.
Clemens F. Hoppe, Secretary, Oriental Silk Printing Co., Haledon, N. J.

Philadelphia Section—
A. M. Burt, Chairman, 1046 Public Ledger Building, Philadelphia, Pa.
Percival Theel, Secretary, Philadelphia Textile School, Philadelphia, Pa.

Piedmont Section—
R. M. Mitchell, Chairman, 808 Cypress Street, Greensboro, N. C.
Arthur R. Thompson, Jr., Secretary, 1109 Independence Building, Charlotte, N. C.

South-Central Section—
R. S. Wheeler, Chairman, Crystal Springs Bleachery, Chickamauga, Georgia.
Lee Roy Hiller, Secretary, Crystal Springs Bleachery, Chickamauga, Ga.

Midwest Section—
Carl E. Bick, Chairman, Real Silk Hosiery Mills, Indianapolis, Ind.
William Bergh, Jr., Secretary, Vassar Swiss Underwear Co., Chicago, Ill.

Lowell Textile Junior Section—
Earle R. McLean, Chairman; Alfred J. Carbone, Secretary.

North Carolina State College Junior Section—
R. A. Gilliam, Chairman, E. B. Hardin, Secretary.

MID-SUMMER MEETING OF SOUTH CENTRAL SECTION

The Mid-Summer meeting of the South Central Section of the American Association Textile Chemists and Colorists was held at the Hotel Patten, Chattanooga, Tennessee, Saturday evening, July 26, with an attendance of 46.

The entertainment given by the Committee on Arrangements was thoroughly enjoyed by all present. Two very interesting and instructive papers were read, one "The Advantages of Bleaching Textiles With Hydrogen Peroxide" by D. Stewart Quern, Field Representative of the Buffalo Electro-Chemical Co., Inc., and one "The Use of Chlorine in Bleaching Cotton Goods" by J. W. Ivey, Technical Representative, the Mathieson Alkali Works, Inc.

Committees were appointed, looking to the entertainment of the National Association which meets with us in December.

The Secretary, L. R. Hiller, having resigned, Mr. J. D. Mosheim, of Crystal Springs Bleachery, was elected in his stead.

Respectfully submitted,
R. S. WHEELER, *Chairman.*

The Use of Chlorine in Bleaching Cotton Goods*

By J. W. IVEY

Technical Representative, The Mathieson Alkali Works, Inc., Charlotte, N. C.

THE process of bleaching cotton goods before the beginning of the nineteenth century was the continued scouring and washing of the goods then hanging them out in the open to get the bleaching effect of the air and sun, but the discovery of chlorine in 1774 completely revolutionized the bleaching industry. At the beginning of the nineteenth century by other discoveries chlorine could be shipped to the bleacher in a commercial form.

Chlorine is a yellowish green gas, of a pungent and irritating odor. It is soluble in water to the extent of two volumes of gas to one of water. This solution rapidly loses strength, especially when exposed to light, the chlorine combining with the hydrogen, for which it has a great affinity, forming hydrochloric acid and liberating free (nascent) oxygen.

It is to this decomposition that chlorine owes its properties as a bleaching agent, the dry gas itself having no such properties. Thus the bleaching process

*An address delivered before the South Central Section, July 26, 1930.

is the oxidation of the coloring matter brought about by the action of the active (nascent) oxygen liberated from the water.

The commercial production of chlorine at the present time is by the electrical decomposition of sodium chloride (common salt) resulting in the formation of pure chlorine coming from the cell as a gas. The sodium combines with water to form sodium hydroxide (caustic soda).

Chlorine is never found free in nature, being too chemically active to remain uncombined. Its greatest affinity is for hydrogen, as mentioned above, and for that reason chlorine was chosen as the ideal bleaching element to be used.

Previous to the discovery of chlorine, it had been found that coloring matter in the cotton fiber could be removed by two processes: 1. By reducing the coloring matter to a colorless leuco compound by the action of nascent hydrogen. 2. By the formation of a colorless leuco compound produced from the action of nascent oxygen. The oxidizing process is the removal of the hydrogen from the water liberating free oxygen, the oxygen oxidizing the coloring matter into a soluble colorless compound that can be washed from the goods, whereas in the case of nascent hydrogen which is also formed from water by hydrolization, this is not always true, due to the fact that all colorless compounds formed by the action of hydrogen are not soluble and when left in the goods are later oxidized back to their original color, and when still in the goods the stain of coloring matter can be seen after the goods are stored for some length of time. Thus for the reason that the oxidized compounds are all soluble, the oxidizing process has been universally adopted.

Of the oxidizing agents, which are composed chiefly of hypochlorites, peroxides, and perborates, the hypochlorites have been adopted as the successful bleaching agents, in that the chemicals necessary for the preparation of the hypochlorites are very low in cost, being manufactured from sodium chloride (common salt) which is the most common of the salts found free in nature.

The hypochlorites, however, when first introduced into the textile industry, did not meet with success in that the bleachers attempted to eliminate the boiling or scouring process, depending on the hypochlorite to bleach both the impurities, or foreign matter, and the coloring matter from the goods. This necessitated the use of hypochlorite of such strength that it not only removed the coloring matter from the dirt and fiber, but also acted on the fiber, causing the fiber to be tendered from the formation of oxycellulose. They then tried to eliminate this by using weaker solutions and allowing it to remain in the goods for a longer period of time. A white could be produced in this manner, but not a permanent one. On ageing, the coloring matter in the impurities would return to its natural color giving a grey cast to the goods. Thus it was then learned from experience that the bleaching agents could only be used for the removing of the natural coloring matter, and only after the goods had been thoroughly cleansed or freed of the impurities, the hypochlorites having a greater affinity for the impurities than for the coloring matter in the fiber.

Many attempts have been made since that time to produce a permanent white on cotton goods both with oxidizing compounds and with reducing agents without first removing the foreign matter from the goods, but none have met with success. Therefore, it can be safely said that the secret of good bleaching is to thoroughly "bottom" or scour the goods before adding the bleaching agents to remove the coloring matter.

Now let's go back one step and take the goods that are to be bleached and see just what condition they are in when they arrive at the bleachery. The fiber as it is brought from the field contains waxes, fats, and motes, which remain in the fiber during the process of spinning and weaving. During the spinning process some plants employ the use of oils, spraying this oil on the goods in order to get better spinning. Then when the yarn reaches the weave room it must be treated with a material to render the goods adaptable for weaving, that is, the warp is treated with a sizing material to give adhesive properties as well as strength to the yarn. Also in some cases where there is a desire to add as much weight as possible to the material, there are additions to the sizing material other than the starches; these additions are sometimes china clay, waxes, sulphates, and chlorides.

The bleacher has enough trouble getting the natural impurities and the natural sizing material from the cloth, but when the additional materials are added not only the bleacher has trouble, but the dyer will experience trouble in attempting to get a uniform shade. Also when sizing materials containing the chlorides are used there is great danger in the singeing process, for the presence of chlorides in goods that are singed will cause tendering. Therefore, it will be well worth the time to learn the nature of the goods and the sizing material used in order that the bleacher may not get the full blame of the damaged goods caused by the singer.

It has been found that in order to remove the above impurities in goods, the only process is to thoroughly boil the goods in a pressure kier using a strong alkali

as a detergent. However, it has been found that the sizing material can be very easily removed from the goods before going to the kier, thus saving in cost of chemicals and time for boiling. This process is known as grey souring, or treating the goods with an acid or micro-organism (better known as a fermentation process).

In the use of acids, the goods are passed through the acid solution in a continuous form having enough slack in the goods to allow a fraction of a minute's exposure to the solution, that is, long enough to assure thorough penetration. The goods are then piled in a J-piler or bin to allow the acid to act on the starch or sizing material, converting it into a soluble dextrine or sugar, from whence it is washed from the goods and then passed on to the kier. The common acids used are sulphuric and hydrochloric acids. The hydrochloric acid not only converts the starch into a soluble sugar, but it will form the soluble chlorides of any minerals in the fiber, chiefly iron. The sulphuric converts the starch and forms the sulphates of the minerals. However, all mineral sulphates are not soluble and are not all removed from the goods, but due to the low cost of sulphuric acid as compared to hydrochloric, the former is most generally used. The micro-organisms or enzymes are used by passing the goods into a ware solution of the enzyme material and allowed to stand at a warm temperature for several hours to allow the fermentation of the starch into a soluble sugar. There are many differences of opinion as to which is the best, this matter is generally decided upon by the bleacher or the strong talk of the salesman.

The grey sour process not only removes all the starches but it also has a tendency to loosen up the natural impurities by softening them to the extent that when the goods are then packed in the kier the detergent may have a quicker action on the impurities requiring a shorter period of time for "bottoming."

The "Kier Charge" or detergent used is chiefly caustic soda along with some assistant which acts as a penetrating agent. These assistants are usually sulphonated oils, pine oils, and solvents such as hydrocarbons, etc. The purpose of the caustic soda or detergent is to saponify the waxes, fats and dissolve the motes, the assistants used chiefly to form an emulsion of the saponified material rendering it easier to be removed from the goods by washing. Some assistants have the properties of aiding the penetration of the goods and preventing the channeling or uneven boiling in the kier. The detergents in circulating through the kier follow the least line of resistance, and if the kier is not properly packed any soft spots will cause the liquor to pass through without cleansing the goods that are more closely packed.

There are other chemicals used in the boiling process, these depending to a great extent on the nature of the goods and the type of boil desired. For milder boils such detergents as soda ash, silicates and phosphates are used. A good bottom may be obtained with the above, but will require a longer process and larger percentage of material.

Small percentages of the silicates are sometimes used, due to the formation of the insoluble gelatenous silicic acid which tends to form a coating on the side of the kier and the chains aiding in the prevention of iron stains in the kier boiling. Sodium silicate when dissolved will decompose into silicic acid and sodium hydroxide, and when heated, part of the silicic acid is decomposed into an insoluble silicic acid, the remainder as a colloidal silicic acid. The insoluble silicic acid is a gelatenous form and will coat the material as well as the kier, rendering the goods somewhat water repellent. For this reason the excess use of silicates is not found advisable in that the goods are rendered repellent to water or chemicals that are to be later used in the bleaching process. It will sometimes cause trouble in the dyeing of the goods, especially with colors that require low temperatures.

The goods after being thoroughly boiled for from eight to twelve hours under pressure with a solution containing from two to three per cent of caustic soda, the percentage of caustic depending on the grade of goods as well as the weight, are then washed thoroughly and passed from the kier to the chemic tank where they are subjected to the hypochlorite solution. When the goods reach the chemic process they are supposed to be free from all foreign matter, leaving the material in a clean condition save for the natural coloring matters that are still present, and if in such state will require only a low percentage of the hypochlorite solution for removing the color.

The chemic solution is prepared by passing chlorine gas into a solution of soda alkali, the alkali being of such strength that the reaction between the chlorine and the alkali will form a sodium hypochlorite solution, that is, when chlorine is passed into a solution in such quantities that one molecule of chlorine is present for every molecule of sodium carbonate, the reaction will give a sodium hypochlorite solution.

If the carbonate is in excess the carbon dioxide gas formed will remain in solution forming the bicarbonates of the carbonate, whereas if the chlorine is in excess the carbon dioxide gas will be liberated resulting in the formation of hypochlorous acid gas instead of the hypochlorites, giving an unstable solution.

Thus we can see that it is very important to have a slight excess of alkali in the solution in order to prepare a stable hypochlorite. Sodium hydroxide may

be substituted for sodium carbonate in the preparation of the hypochlorite solution, thus:

$$2NaOH + Cl_2 \longrightarrow NaOCl + NaCl + H_2O$$

In this case also a little unchlorinated alkali should be present in the solution to render the preparation stable.

The present method used for preparing hypochlorite solutions is the addition of both sodium carbonate and sodium hydroxide; the hydroxide forming the stable chemic. The excess alkali being the carbonate which leaves the solution with the carbonates present instead of the bicarbonates, giving a solution that is stable when in solution but when exposed to the air while in the goods the carbonates are more easily converted than the hydroxides, giving a solution that is stable enough to be carried in a stock solution for several days and then when used the bleaching action will be faster than when straight caustic soda is used.

In the process of chemicing the goods, the strength of the chemic is governed by the type of goods, the weight of material, and the thoroughness of the boil or scouring. The chemic is always used in a cold solution, that is, the temperature of the chemic should never be allowed to go higher than 90° Fahrenheit. This is important due to the high oxidizing potential or activity of the hypochlorite. When excessive temperatures are employed all oxidizing agents are made very rapid in their action, and in the use of the hypochlorites, the action is too rapid unless the process is accurately controlled. The present method of bleaching seems to rely upon the slow action of the cold chemic rather than to attempt to speed up the bleaching operation by employing chemical control which would require the additional time of a person capable of controlling the process.

Tests have shown that goods of ordinary structure may be bleached with a hypochlorite solution with as high as four grams per liter of available chlorine without endangering the fiber itself provided the temperature is not allowed to exceed 90° F. The length of time necessary for the oxidizing of the coloring matter is from twenty to forty minutes when the oxidizing is carried out in the J-piler, this allowing the goods to be constantly exposed to the action of the carbonic acid gas of the air which reduces the hypochlorite solution to hypochlorous acid gas liberating nascent oxygen, which is the element that oxidizes the coloring matter into a soluble leuco compound that may be removed from the goods.

The goods after being chemiced, are washed thoroughly, then treated with an acid or anti-chlor for the purpose of removing any excess hypochlorite or chlorine that might have remained in the goods after washing. Should any chlorine remain in the goods it would cause the goods to be yellowed and tendered because of the excessive oxidizing action on the goods and the formation of oxycellulose.

The bleacher should always test the goods for chemic and acid at each stage of the process; after each particular washing process has been completed. Starch iodide paper turns blue in the presence of chemic, and methyl orange paper should be used in testing for acid. If these latter tests are always carried out there would never be a need to fear tendering from the effect of acid being left in the cloth after the final wash.

Mention should be made relative to the alkalis for scouring the goods as well as the alkalis for preparing the chemic. The chemicals commonly employed by the bleacheries where mercerization is done, is to use the wash water from the mercerizing machine for scouring the goods as well as preparing the chemic. The wash waters are collected in a separate storage tank and held in reserve for the bleaching process. Here the per cent of alkali present in the solution should be determined by titrating for the sodium oxide content instead of depending on the hydrometer the density of the solution. In order to get uniform and successful boils in the kier the same per cent of alkali should be used for every boil, and when the strength is determined by means of the hydrometer there is a danger of having the wash waters from the mercerizing machine contaminated by impurities which would raise the density of the solution resulting in an insufficient amount of alkali in the kier charge. The titrating process is very simple and can be very easily adapted to the bleachery.

The use of chemical control or titration should also be employed in the chemicing process. We might say that this is more important than in the kier charge, for the chemic solution has more chances of having the density of the solution changed by foreign matter. If the density of the chemic is changed by foreign matter the goods will not receive sufficient chemic, even though the density may remain the same, resulting in uneven bleaching through the day's run, especially in the continuous bleaching process.

In bleaching, which is the whitening of the fiber, it is very important to purchase chemicals that are free of impurities, for when improper chemicals are used, you not only have to remove the impurities that are in the goods on coming to the bleachery but you have the problem of removing the stains that occur from the use of off-grade chemicals. Chemicals containing iron should especially be avoided, for iron will cause a stain in the goods, and when iron is present in the process of bleaching under high temperature the goods

will be tendered by the action of the oxidizing agent on the iron salts.

Chlorine offers to the bleacher an element that will produce a preparation for bleaching that can be safely handled, economically prepared, and a preparation of high oxidizing ability, such that it requires the minimum amount of chemicals necessary for producing the desired white.

In the use of hypochlorites for bleaching of piece goods we employ the continuous process, that is, the passing of the goods, after being bottomed in the kier, in a rope form through the chemicals and washing processes. This results in better penetration of the goods and more thorough washing in a shorter period of time. Also in the continuous process the goods are in constant view of the bleacher in order that he may observe the actions of the chemicals and guard against any undesirable actions taking place.

As previously mentioned, there are two distinct processes in obtaining a good white on the goods. First, the goods must be thoroughly scoured or bottomed, in order to remove all impurities, leaving a clean, pure cellulose product, except for the natural coloring matter in the fiber which may be easily removed by any oxidizing agent. The hypochlorites have been adapted for this process in that the hypochlorites when reduced to form the oxidizing compound (oxygen) leave salts that are soluble and readily removed from the goods by washing, whereas in the use of some bleaching compounds, there remains in the goods insoluble compounds that cannot be removed, and will in some cases effect the penetration of the goods in dyeing and printing. Bleached goods are supposed to be free from all impurities, and when in such state will have a natural soft feel, be readily absorbent to water and dyestuffs, giving an even and uniformly dyed fabric as well as a shade that will, when dyed with fast colors, be permanent.

The above discussion has dealt chiefly with the bleaching of white piece goods, however, at the present time with the production of colors that are fast to chlorine or oxidizing, there has been a great demand for goods that contain stripes or designs produced by dyed yarn. These colors are fast to chlorine bleaching, but when boiled with a strong alkali will mark-off, fade or cause stains in the white portion of the goods which cannot be removed by bleaching. The hot alkaline liquor appears to exert some reducing action on the color causing the colors to stain the white portion while being bottomed. There has been no definite data as to the effect of the alkali on the dyes. However, it appears possible, as has been claimed, that sodium hydroxide forms a chemical compound with cellulose and starch, forming some nascent hydrogen which would of course have a very decided reducing action on the colors when in direct contact. It appears that the nascent hydrogen forms in only a small trace when goods are boiled under high pressure with strong alkali, yet there is enough to cause some of the dyestuff to be reduced.

This caused more research work on the bleaching of partially dyed goods, and resulted in a product being produced that when added to the alkalis in the kier boil prevented the reducing action on the dyes. This product had the property of being more easily reduced, thus taking up the nascent hydrogen formed before it has a chance to attack the dyes. This compound has found a great field, and is being used very successfully for bottoming striped goods with strong alkalis, giving a thorough bottom for bleaching.

In the above discussion we have given the general method of bleaching cotton piece goods and some complications that might occur, yet we find that it is a simple process of elimination; by this is meant the elimination first, of the starches added to the goods, secondly, the elimination of the remaining starches and other natural impurities and foreign matter, then thirdly the elimination or removing of the natural coloring matter that is present in the fiber even after it has been thoroughly scoured. All of this is done for the sole purpose of giving a piece of goods that will be free from all impurities which may be either sold in the white form or may be dyed or printed with fast colors. The cleaner the goods, the more suitable they are for dyeing or printing. The danger of producing uneven shades or spots in the cloth is prevented.

In the bleaching process there are some precautions that may be well worth mentioning.

In grey souring the goods, care should be taken to see that all traces of acid are removed from the cloth before going to the kier. Any acids remaining in the goods will neutralize some of the alkali used for scouring, resulting in insufficient alkali for giving the desired bottom.

In loading the kier with goods, if done by labor, care should be taken to see that the person plaiting the goods in the kier is experienced in this type of work. Improper packing of the kier will cause channeling, resulting in streaks or stains in the goods. Care should also be taken to see that the kier has been washed or painted with lime and silicate or some substitute that will prevent iron stains in the goods from the kier.

In preparing the detergent or kier charge, it should be dissolved and mixed in a separate tank with water volume sufficient to just cover the goods in the kier. The charge should not be added until the kier is ready to be boiled. It is not advisable to allow the kier liquor to stand in the goods before or after the boil-

ing process. The chemicals used for scouring should be as clean as possible and especially free from iron and materials. These impurities produce stains in the goods that are not always removed in the bleaching and washing process.

When bringing the kier to a boil, a suitable valve should be placed in the top of the kier lid, such that it may be kept open until all traces of air and gasses have escaped.

In preparing the hypochlorite solution, care should be taken to see that there is an excess of alkali in the solution to prevent the waste of chlorine by the formation of an unstable chemic.

In bleaching, the strength of the chemic used should be checked at least every fifteen minutes, by titration, for the available chlorine. The available chlorine by titration, as compared to density may be different due to the contamination of the chemic solution by certain impurities washed from the cloth.

After chemicing, the goods are then washed and treated with an acid or anti-chlor. If acid is used, the goods should be tested with methyl orange test paper before leaving the bleachery to be sure that all traces of acid have been washed from the goods.

Thus we find that with only a few precautions, the bleaching of goods with chlorine can be successfully performed, and with a cost lower than any other process. Not only will the cost be lower but the goods will have a permanent white and a feel to the touch that cannot be obtained by other processes.

It may, therefore, be said in concluding, that hydrogen peroxide bleaching of piece goods derives considerable advantage from its simplicity. Not only does it offer the bleacher a high quality product, but it is accomplished with a minimum of time, labor, equipment and space. With the general modern trend toward doing things in the simplest and most direct way, it is natural that peroxide bleaching should have grown to the proportions in practical use which it now enjoys.

PIEDMONT SECTION TO HOLD ANNUAL MEETING, CHARLOTTE, N. C., OCTOBER 18, 1930

THE annual meeting and election of officers of the Piedmont Section will be held in Charlotte, N. C., on October 18. A very interesting technical program, as well as entertainment and special features, are being arranged by the committee in charge. Further details regarding the program will be announced about October 1.

Reservations should be made in advance by addressing the Secretary, A. R. Thompson, Jr., 1109 Independence Building, Charlotte, N. C.

Water for the Textile Industries*

By A. S. BEHRMAN

Chemical Director, International Filter Co., Chicago, Ill.

LIKE many other industries, the textile world is rapidly awakening to the importance of the quality of the water supply it uses. This applies not only to the manufacture of the textiles themselves, but to the subsequent handling of the finished product.

It was not mere chance that the first important centers of the textile industries in this country were located in New England. The abundance of comparatively pure water was a most important factor in determining that location.

Thanks largely to the work of the water chemist and of the chemical engineer, it is no longer necessary to locate a textile manufacturing or finishing plant in a region provided by nature with good water. With relatively few exceptions, it is now possible to make a satisfactory water out of almost any natural supply. Location of the plant can, therefore, be determined by the other vital considerations entering into the most efficient and economical manufacture and distribution of the products concerned.

REQUIREMENTS OF A GOOD WATER FOR TEXTILE PURPOSES

What are the qualifications of a good water for textile use? The answer is almost self-evident.

The water must be clear—that is, it must be free from turbidity or suspended matter of any kind, in order to avoid muddying and spotting the fabric, and to prevent uneven dyeing.

The water must be colorless, or it may impart some of its color to the fabric.

The water must be soft, in order to permit thorough and economical washing, and in order to avoid spotting, uneven dyeing, and the host of other evils which are too well known to need further comment.

The water should be free from iron, to prevent rust stains and other troublesome precipitations. In rayon work in particular, the complete absence of iron is of prime importance.

Finally, the water should be non-corrosive, since even if initially pure, it may become thoroughly undesirable if it attacks iron or other metallic surfaces with which it comes in contact and so is contaminated with compounds of the metal.

CLEAR WATER

The practically universal method of removing mud or other suspended matter from water is by means of filtration through sand.

It is not enough, however, to rely on the sand alone; for a sand bed, like any other strainer, can only remove

*An address delivered before the Midwest Section, May 24, 1930.

particles of suspended matter which are larger than the spaces between the sand grains. Since these spaces are a great many times larger than the tiny particles of silt, clay or other similar causes of turbidity, it is obvious that passing a turbid water of this sort through a sand filter at the high rates which are now employed would result simply in straining out the coarsest particles of suspended matter, while the finer particles would go on through.

This situation is met by adding to the water one or more coagulants—such as alum, sulphate of iron, sodium aluminate, ferric chloride, etc. — whose function is to collect these very fine particles of suspended matter into clusters or clumps which are larger than the spaces between the sand grains, and which will, therefore, remain on top of the filter sand when the water is passed down through the bed. All of these coagulants form in water a jelly-like substance which attracts the tiny particles of suspended matter and gathers them into the desired larger aggregates.

In some cases it is sufficient to add the coagulant to the water just as it enters the sand filter. This is the case in the usual pressure filter installation. Frequently, however, additional time must be provided for the coagulant to do its work before the water passes to the filter.

If the amount of suspended matter in the water is quite small, the task of removing it may be placed entirely on the sand filter, provided, of course, that the water is properly coagulated before it goes to the filter. If, however, as is frequently the case, the water contains a considerable amount of turbidity, a sand filter would be clogged up very quickly if such a water were passed directly to the filter after being coagulated. In such cases the water, after the addition of a coagulant, is run into settling tanks where as much as possible of the coagulated suspended matter is settled out. The settled water is then passed through sand filters to remove the last of the suspended particles and so to deliver a sparkling and clear effluent.

Time will not permit me to go into details of the design of typical filtration plants, and of the careful study of the character of the water and of the engineering considerations which should be made before any installation of a filtration plant is begun. The apparent simplicity of a filtration plant is quite deceptive, and only engineers or engineering organizations with specialized experience in this field should be entrusted with the design and installation of water purification plants.

Colorless Water

The coloring matter of natural waters, is, for the most part at least, not really in solution at all, but in the form of a very fine suspension. A water may be colored a bright yellow or light brown and look perfectly clear to the casual observer; but it may readily be shown that the particles of coloring matter are in suspension by treating the water with alum or some other coagulant, whereupon the colored particles are brought together and can then be removed by settling or filtration, or both.

It is general practice to remove color from natural waters by coagulation and filtration, so that in many cases of surface waters which are both colored and turbid, the color and turbidity are removed at the same time.

It should be pointed out, however, that it is usually a much simpler job to produce a clear water than it is a colorless water, and it is here that the chemist becomes especially important in working out the most effective and economical method by which the color may be removed.

In some waters the color can be bleached out with chlorine. This fact has suggested a new method of color removal which consists in destroying the color with an excess of chlorine and then removing the excess of chlorine with activated carbon. Hydrodarco, the activated carbon used by the writer's organization, has a remarkable affinity for chlorine, and combines chemically with it.

Where it is possible to remove the color from a clear water by means of excess chlorination and subsequent treatment with activated carbon, coagulation and sand filtration may be eliminated entirely.

Soft Water

Few industries have realized the importance of soft water as quickly as the textile industries. It is not enough that the water must be reasonably soft; for many textile purposes the water must be entirely free from hardness.

For this reason the textile industries were among the very first purchasers of zeolite softening plants, and now it is only the exceptional textile works which is not thus equipped.

You are all familiar with the principles of the zeolite or base exchange softener—how the lime and magnesia in the hard water are replaced by soda from the zeolite, which becomes a lime and magnesia zeolite in the process; and how, after the zeolite has given up all of its readily replaceable soda, and has thus become "exhausted," it is regenerated with a solution of common salt which drives out from the zeolite the lime and magnesia which have been taken up, and gives to the zeolite a fresh supply of soda with which it can resume its softening operations.

We have become so accustomed to our zeolite softeners that we are very likely to forget that no one—not even we chemists who are charged with developing "bigger and better" zeolites—knows exactly how a particle of zeolite operates in exchanging its soda for lime and magnesia of the hard water with which it comes in contact. We have our theories and our suspicions, but up to date there is no generally accepted picture of just what takes place in a zeolite molecule in either the softening or regeneration procedures.

Probably the most interesting developments in zeolite softeners have been in the zeolites themselves. The first zeolite used for water softening was made in Germany in the first decade of the twentieth century, and was prepared by melting together the proper proportions of the appropriate constituents. The principal difficulty with this zeolite was that it was too slow both in softening and regeneration. The regeneration process, for example, required 8 to 12 hours.

The same objections held largely true for the zeolite which shortly afterwards appeared in this country and which was made by processing a certain kind of clay.

The first of our really modern zeolites put in its appearance near the end of the second decade of the century. This, as you know, was greensand.

In contrast to its predecessors, greensand was quite rapid in its action, both as to softening and to regeneration. The principal objection to greensand was, and still is, its low base exchange capacity — that is, the small amount of water which will be softened by a greensand softener of a given size.

The next and most recent development in zeolites is the gel type, in which is combined the rapid action of greensand and a water softening capacity several times that of greensand. To this type belongs Crystalite, the gel-zeolite manufactured by the writer's organization.

Since the new zeolites will soften from two to four or five times as much water as the same volume of greensand would accomplish, it follows that a much smaller softener with the new zeolite will do the work of a much larger greensand unit By the same token, a Crystalite softener of the same size as a greensand softener will furnish several times as much soft water between regenerations as will the greensand unit, and with only a fraction of the labor and wash water required for the greensand.

Unfortunately, the zeolite situation is likely to be confusing to the layman because of pending litigation in connection with both zeolite softening apparatus and with the zeolites themselves. For this reason, a prospective purchaser of zeolite equipment will do well to make sure that the softener he is thinking of buying does not infringe any patents on either apparatus or zeolite mineral. There are several manufacturers—but only a few—who can properly give this assurance.

Non-Corrosive Water

The last few years have seen a decided advance in our understanding of why some waters will corrode iron pipe and some will not. Time will not permit me to discuss the theory of corrosion as it is now rather generally accepted, nor to take up in detail the methods of preventing corrosion.

It will be sufficient to say here that the corrosion of iron pipe by water may be determined pretty definitely by an analysis of the water. Provision should, therefore, be made in advance either to treat the water so that it will be non-corrosive, or else to make the piping and other metal surfaces with which the water comes in contact of materials that are in themselves non-corrosive.

Waste Water Purification

Of steadily increasing importance is the purification of waste liquors from textile works, and particularly from dye houses. Up till the present, the subject has been of practical importance in only those few states in which the health boards have police powers and can compel the owner of an industry to stop polluting a water course. In the rest of the states, in the absence of such police powers in the health boards, most of the industries are trying to put off the evil day as long as possible and are content to let matters take their course.

With our steadily growing population, and the ever-increasing use of surface water for public water supplies, it is only reasonable to assume that the day of reckoning is not far off, and is approaching with accelerated rapidity. It would, therefore, seem to be wisdom on the part of the textile industries to be prepared for the day of judgment, and possibly even anticipate it, since a program voluntarily adopted after an intelligent analysis of the situation may well be considerably more effective and economical than one imposed by governmental regulation.

There are several methods of accomplishing this purification. If the liquors contain much suspended matter, the same combination of coagulation, sedimentation, and filtration used in water purification frequently gives the desired result. If the liquors are relatively clear but highly colored, they may frequently be decolorized by an active decolorizing carbon such as Hydrodarco. If the liquors are excessively alkaline, carefully controlled neutralization may be the simplest answer.

There are so many variables which may enter into the composition of waste liquors, that the most advantageous method of purifying them can be diagnosed accurately only after a careful and complete analysis of conditions—not only as to the character of the liquors themselves, but as to the operation of the plant, the character of the adjacent drainage area, and other considerations which are peculiar to the particular case at hand. Here again the chemist and the chemical engineer frequently play an important part in working out the most economical and effective treatment.

Conclusion

In this brief address it has been possible for me to sketch only very briefly and in general terms the more important problems of water purification for the textile industries, and the most modern methods employed for solving these problems. If I have succeeded in leaving with you even the most general sort of picture of the situation, the occasion has been worth while.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

BLISS MORRIS JONES
Managing Editor

MYRON DREW REESER
Advertising Manager

Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES, President — M. D. REESER, Secretary — H. F. CRAWFORD, Treasurer

Subscription price $5.00 per year; Canadian $5.50; foreign $6.00

Vol. XIX September 29, 1930 No. 17

THE SMALL LABORATORY

IT IS now a fairly well established policy for the larger companies connected with the dyeing and finishing industry to set aside a definite sum each year to be used for laboratory work. With the small plants the laboratory is all too often thought to be of so little value that it is not considered worth while to expend money on it. Whether or not the small plant is justified in its view is an open point. There are advantages and there are disadvantages; in some small plants, one might outweigh the other and vice versa. However, many small plants that have tried using the laboratory, have found it indispensable; the others that have not tried it have no way of knowing whether or not it would help them.

That a completely equipped laboratory is an expensive proposition is undoubtedly true; what is equally undeniable, is the fact that a small laboratory, sufficient for all the general problems of any works, can be equipped and operated at a relatively small cost. Certainly the cost is small enough to warrant a trial over an extended period of time, that is, until the beneficial results derived from its use might firmly establish its value.

The small works laboratory is, and should be, quite different from the large laboratory which has expensive apparatus, high upkeep, and a staff specialized in all departments of research and production. The large plant can afford to have men engaged in specialized research. Such an organization is content to let the business "carry" the laboratory on a chance that, in the long run, important discoveries will be made. The small works should have a laboratory, not for specialized research, but rather as a place for routine plant work. It would provide a place in which to try out modifications of processes on a small scale, a station where the quality of raw materials supplied to the firm could be checked, and most important, where tests could be made regularly on outgoing samples of the firm's goods. Few plants have not experienced the loss of both time and money that is caused by the return of faulty goods which might have been avoided by using laboratory tests.

Second only to the fear of the cost of a laboratory, is the fear that the proper staffing of such a laboratory in the small works would be too great an expense. The personnel, however, should present no great difficulties; not only are fewer men needed than in a large laboratory, but men of extra high qualifications are not required. For most small firms setting up such a laboratory, one man and a "bottle washer" is sufficient. The man in charge should be one with good all around ability, rather than a specialist. The specialist is too often primarily concerned with but a narrow branch of knowledge and thus would have less interest in routine laboratory work.

The practice of some small firms to do without a chemist and have the plant manager do the work is frequently false economy. It is unfair to expect good results from a highly skilled craft when it is run as a spare-time occupation. Even more to be deprecated is the practice of attempting to have the laboratory in charge of an untrained man. The successful utilization of a laboratory depends upon its being conducted in a scientific manner which could best be done by a man with a degree in chemistry. A well-trained man direct from college should be able to carry on the work satisfactorily, and his salary would not be too much of a burden on the firm.

The advantages to be derived from the proper use of a laboratory in a small plant are beyond question. Production cost is often lowered, better products are turned out, and the risk of a break-down and accident is minimized. Furthermore, the manufacturer will be doing a great deal of good by giving a start to many young chemists. It is quite generally realized at the present time, that the progress in industry is largely dependent upon the advancement of scientific knowledge.

COLOR BY WIRE

A DISPLAY of devices that "measure" a color or shade so that the "measurements" can be telegraphed or cabled to a distant point where the color can be reproduced and matched identically has been proposed as one of the central exhibits at the 1933 Chicago World's Fair to illustrate advances made in spectroscopy. The proposal is contained in a report of the physics and optical physics division of the National Research Council Science Advisory Committee outlining an extensive series of physics exhibits for the 1933 exposition.

"The dominant note of this exhibit," states the report, "should center about the fact, first, that any color may be measured; second, that this measurement, unaccompanied by any color sample, may be transmitted either by mail or telegraph to any part of the world; and third, that upon receipt of such measurement at some distant point the identical color may be created anew."

These color measuring devices employ a scientific principle used in spectrum analysis in which colored rays of light are indicated by certain lines and curves after separation by refraction through a prism. Thus a woman in New York who desires to match a piece of velvet in Paris can take a piece of that material and obtain what is known as its "spectral curve" which will be produced by the color measuring apparatus in the metropolis, this spectral curve can then be cabled to Paris where the measurements can be used to reproduce the exact shade of the New York material.

In order to impress the importance of this exhibit upon the public at the Chicago Fair, the report recommends that an attendant be provided at the exposition who would assist visitors in matching any available substance, and who would explain that the readings obtained by the color measuring device "may be telegraphed to a distant point and immediately set upon an identical instrument for the purpose of reproducing the color of the substance measured."

EXTRACTORIALS

Mr. Evans said that, in common with all other organizations, the university had undergone a new orientation. The scope of the higher branches of learning had been broadened, and, owing to the complexity of modern industrial problems, there was an increasing tendency on the part of industry to reach out to the university for some guidance. The university graduate who intended to become a leader of industry must be equipped not only with technical and scientific knowledge of the broadest kind, he must have vision and a knowledge of the world and men. Academic training alone would not suffice, and he would urge students to take every opportunity, during their vacation, to enter the practical field of industry and thereby cultivate sympathetic contact with those workers who had not the privileges of a higher education, but who, nevertheless, were men skilled in their work, and were the foundation of most industrial processes.—*Chemical Age.*

It is true that some progress is being made toward the elimination of factory injuries, but the headway that is being made is not anywhere near what it should be. Perhaps it is because we do not know enough about the causes of injury. *Fatigue, worry,* and *inexperience* have often been pointed to as being conducive to broken bones, but we find in looking over extensive records that these are not the main causes.

The thing which is responsible for the large bulk of human suffering is the "wrong attitude." This doesn't mean disloyalty, antagonism, or anything of that nature. It merely means that the employer and employee alike fail to see danger where it exists. A good many men do not know that they are skating on thin ice until they break through. We must sharpen our eyes and ears to the point where we recognize hazards.—*Consolidated News.*

"Standards should be created for all materials. These should include minimum specifications for yarns, piece goods, and manufactured articles. They should embrace tests, the results of which will convey to the ultimate consumer the desired information.

"Many of you present may claim that such a procedure will build up sales resistance because of consumer doubt. I must emphatically state, however, that I cannot agree with you, because we have experimented and we are in a position to know.

"Two years ago we notified our public that we did not guarantee the wearing qualities of transparent velvets. Ladies who considered the life of the garment more important than style bought other merchandise. The sale of transparent velvets, however, increased by leaps and bounds, and the complaints dropped to nil."—*Ephraim Freedman in B.L.N.A.*

A manufacturer stated recently: "We operated at night during the war to meet an emergency; we continued it after the war to meet a price; we have persisted in it of late to take care of our workers." Today, more and more manufacturers are becoming convinced that they can take care of their workers, not through night running, but through its elimination.—*Textile World.*

The public cannot be induced to buy unattractive goods when better goods are offered. There is too much ability and intelligence in the distribution trade to permit retrogression. However, there are producers who cannot see that the market has outrun their product and who feel that a large demand will develop eventually for out-of-date goods. No such possibility exists and if a demand does develop it will be for improved fabrics and because of value and not for the older styles. It also is difficult for some to understand that older methods of production have a high cost and produce less attractive results.—*Daily News Record.*

One of our customers, who more than doubled their advertising appropriations January 1st—three months ago felt they had made a mistake. The big increase in their business during the past six weeks has proven to them that they were right—and that the best thing they ever did was to double their appropriation January 1st.—*W. H. Rankin in Advertising Club News.*

If depression causes thinking, then depression will result in new and greater profits.—*C. F. Reeves in Molded Products.*

After all is said and done, our award for the best advertisement of the year would go to the man who, lacking funds, placed a large bowl of water in his window and labelled it "Filled with Invisible Goldfish from the Argentine." He got the crowd.—*The Forecastle.*

Design Registration Surmounts Retail Opposition

By WALDON FAWCETT

THE action of the U. S. House of Representatives giving approval, in the final days of the last Congressional session, to the Design Registration Bill is quite the most significant development to date in a movement that is of both direct and indirect significance to the textile coloring industry. This formal acceptance by the Lower House of Congress is meaningful in that it brings half-way to realization, the prolonged project to replace the U. S. design patent system with a design copyright system which would be much more sympathetic to color in design. Equally impressive, is the circumstance that acceptance by one branch of the national legislature signals defeat for the most formidable element of opposition that has sought to block the path.

Almost from the inception of the crusade originally staged by the Design Registration League, members of the dyestuffs industries have sensed the ultimate benefit to them in a simpler, less expensive, and more elastic system of design protection. The prejudice at the U. S. Patent Office against color as an instrument of individuality in design, has irked. So, too, has the insistence that a design, to be patentable, must disclose "invention" rather than authorship. Consciousness of an active participation in the issue impelled Joseph H. Brohel of the United Piece Dye Works of New Jersey, and other members of the trade, to journey to Washington to support the silk manufacturers and other proponents when they laid before the Congressional committee this year, a picture of the evils of design piracy.

Thus committed to the Design Registration Bill or Vestal Bill, so-called, color and textile tradesmen were both surprised and disquieted when, in the later reaches of the movement, opposition appeared in certain retail quarters. There was, perhaps, cause for anxiety if the antagonism of the National Retail Dry Goods Association bespoke a resentment universal in distributive circles. Added to that, was the shock of a belated resistance which appeared when the design protectionists had reason to feel that they had laboriously reconciled all opposition. Several groups of dissenters challenged the design copyright proposition at earlier stages of its progress. For example, there was necessity, at one juncture, to allay the apprehensions of the manufacturers of paper patterns and the publishing interests that voiced misgivings lest the prospective legislation hamper exploitation of the trends of fashion. Then, when the coast was supposedly clear, thanks to amendments inserted in the bill, behold the eleventh-hour objection by retailers.

The protest by organized merchants, which was so pointedly ignored by the House of Representatives, is designed to make sure that retailers are not, by any chance, made the victims of quarrels over design rights. What the retailers demanded, concretely, was a special amendment enabling a merchant to collect damages for loss of sales and attendant profit, if said retailer was unwarrantably compelled to cease the sale of a design, that, upon test in court, proved to be lacking in the degree of originality necessary to support a design copyright. The plea of the retailers' lobbyists was that an amendment to this effect would deter would-be monopolists of design from subjecting distributors to litigation on doubtful grounds.

The action in Congress disregarding the alarms of the department store executives was the more conclusive in that it came deliberately after H. S. Ames of Wright, Cumler Company, and other spokesmen, had poured into the ears of members dire prophesies of what would befall store buyers confronted, in addition to the buying problem, the style problem, and the fashion problem, with the constant question of design infringement. When P. L. Ryan appeared in Washington to oppose the design bill on behalf of R. H. Macy & Company he was asked by Congressman Perkins whether the retailers would be appeased if the design bill were limited in its application to cover silk goods and designs on fabrics—most of the arguments having been aimed at the difficulties of determining originality in textile designs. The Macy representative said that he believed that a design bill restricted to textiles would hamper retailers less than the broad bill. But, neither he nor other retailers, to whom the same question was put, were enthusiastic over that solution. Under cross-examination by members of the Patent Committee the lobbyists for the retailers left the impression that they favored no protection for designs unless a design candidate be susceptible of proof of possession of absolute originality. With the Congressional supporters of Design Copyright committed to the idea that literal originality is rare and that design creation is largely a matter of rearrangement, adaptation and improvement of elements old in the arts, it may be imagined that this exaction for the virtually impossible as a basis of protection was not convincing of sincerity.

Futility of retailer-opposition to design protection is traceable in no inconsiderable degree to the fact that the attack of the department store group has been directed pointedly against the manufacturers of textiles and other expressions of design, who have been pictured as seeking monopolistic control and increased profits at the expense of the peace of mind of retailers. This arraignment is ill-calculated to make impression upon the Congressional conscience, thoroughly converted to the idea that design protection is destined not for the benefit of manufacturers so much as for the adequate reward of designers and, indirectly, for the well-being of the consuming public which stands to benefit ultimately by the stimulation of artistic inspiration and encouragement of the creation of objects of beauty. As Congressman Perkins remarked on one occasion, the idea of the sponsors of the Vestal Bill is to protect manufacturers, but, incidentally, and through the designers.

At the earlier stages of their propaganda, the retailers who have led the fight against design registration, made much of the argument that the Vestal Bill would create

a monopoly of designs and, therefore, increase prices to the trade and to the public. Refutation of this was accomplished largely through the efforts of Frederick H. Knight, treasurer of the Susquehanna Silk Mills. In communications to Congressmen he reasoned that the effect of protected designs would be to reduce costs in that production costs would be spread over a greater volume of output. His slogan is: "Design piracy means short yardage; design protection means long yardage."

The Design Registration Bill now goes to the U. S. Senate for action and by way of urging expedition, representative members of the textile industry will call attention to the situation which has been precipitated by the close trailing of the pirates. This point was covered by Stephen A. Walser, who, in relating the plight of Schwarzenbach, Huber Company, said: "Formerly we had time between the date of issue of our samples of our prints and the reproduction in the cheaper fabrics to allow us to make deliveries to our customers and then reproduce these same designs on cheaper cloths before competitors were able to copy our designs. This year they have been so quick with their copying that within 30 days after we advertised and distributed our samples they already had copies on the market."

There has been, in the discussions at the U. S. Capitol, frequent reiteration of the statement that design piracy in the textile lines means inferior materials in dyes as well as in fabrics. Only casually mentioned but perhaps deserving of greater attention is the economic loss involved in the necessity of redyeing fabrics the value of which has been impaired by piracy. The firm of H. R. Mallinson & Company has the prime example of this last species of waste. In the case of its "bubble" design, so-called, one customer, when overtaken by the piracy, had on hand 500 pieces of the material which he felt obliged to redye black and distribute at a lower price. Officers of the United Piece Dye Works have cited, to the same end, an unfortunate experience in service of the Stewart Silk Company. An order for 1,000 pieces was in process and little more than half completed when, through the circulation of the strike-offs, the pirates became active with the result that the unfilled portion of the original order, 400 pieces, was cancelled and a considerable portion of the delivered stock was returned for redyeing.

Representatives of the retailers' organization which has led the lobby against design registration announce that they will renew, in the U. S. Senate, this winter, their fight against the Vestal Bill. Frankly, they have considerable momentum to overcome. There has been, instinctively, in the upper house, a strong sentiment favorable to design copyright. Furthermore, there is, traditionally, an impulse for the Senate to automatically concur in any special legislation of this type which has, in accordance with custom, originated in the House and been approved there after full investigation. The chances for design protection in the Senate have been improved by a change in the personnel of the Senate Patent Committee which must give a preliminary O.K. ere the bill goes on the calendar. The former committee was not avowedly antagonistic but procrastinated in so far as design and trade mark legislation was concerned.

ABSTRACTED PROCEEDINGS OF THE AMERICAN CHEMICAL SOCIETY

The following are abstracts of the paper given before the Division of Dye Chemistry of the American Chemical Society at the meeting in Cincinnati, Ohio, September 8-12, 1930.

Preparation of 2-Amino-anthraquinone from Bromobenzene and Phthalic Anhydride. P. H. Groggins, A. J. Stirton, and H. P. Newton.

Bromobenzene has been condensed with phthalic anhydride according to the Friedel-Crafts reaction. The keto acid thus produced was converted to 2-bromo-anthraquinone with yields in excess of 95 per cent. The purity of the halogeno anthraquinone varied directly with the residual acidity of the sulfuric acid used in making the ring closure, the product being purer with higher concentrations of acid. The yields, however, increased with lower acidity or greater dilution of the dehydrating acid.

The conversion of 2-bromo-anthraquinone to 2-amino-anthraquinone was easily accomplished. Temperatures as low as 150° C. could be used. 2-amino-anthraquinone of 98 per cent purity could be obtained directly with an ammonia ratio of 10 to 1 at 165° C. Despite the comparatively high cost of bromo-benzene, the process may prove commercially attractive owing to the high yields and pure products obtained.

A New Group of Anthraquinone Vat Colors Containing the—CONH—Linkage. Ralph N. Lulek.

The object of this paper is to discuss a series of recently developed anthraquinone acid chlorides and their condensation products with amino-anthraquinones. Most of the products in question are covered by patents and some of the dyestuffs discussed are in the trade. Some of the acid chlorides which will be discussed are 1:9-anthrathiazole-carboxylic acid chloride (—COCl in 2, 4, and 5 positions, respectively), 1:9-anthraselenazole-2-carboxylic acid chloride, 1:9-anthrathiophene-2-carboxylic acid chloride, and others.

New Benzoyl-ortho-benzoic Acids and Their Anthraquinone Condensation Products. I. Gubelmann, H. J. Weiland, and O. Stallmann.

A new method for the manufacture of 2,7-anthraquinone bodies from benzoyl-ortho-benzoic acids is described. The general process consists in nitrating 4'-sulfo-2-benzoyl-benzoic acid whereby there is formed 4'-sulfo-2-benzoyl-5-nitro-benzoic acid. This latter product is either reduced to the corresponding amino body or it is condensed by means of dehydrating agents to the corresponding 2,7-substituted-anthraquinone. The reduction product can likewise be

condensed in sulfuric acid to 2,7-amino-sulfo-anthraquinone. Various derived products from the above formed 2,7-amino-sulfo-anthraquinone and the 2,7-nitro-sulfo-anthraquinone are described, including 2,7-diamino-anthraquinone.

A Discussion of the Reactions Involved in the Preparation of Aminoazo-benzene from Aniline. E. F. Hitch, M. A. Dahlen, and M. E. Friedrich.

Two general explanations have been offered of the formation of aminoazo-benzene by the interaction of aniline hydrochloride, aniline, and nitrous acid: (1) Aniline hydrochloride is diazotized to diazobenzene chloride, this reacts with aniline to form diazoaminobenzene, and the latter rearranges under the influence of a suitable catalyst, in this case aniline hydrochloride, to aminoazobenzene; (2) Diazobenzene chloride, formed as above, couples directly with aniline to aminoazobenzene. An analysis of experimental results already available, together with some new observations, indicates the latter is the proper explanation.

The Magenta Series: I. The Preparation and Spectrophotometric Study of the Lower Basic Members. John T. Scanlan.

The commercial basic magenta (Fuchsin), supplied for use as a biological stain, is in most cases a mixture of two or more of the three well-known members, together with a fourth not usually mentioned, but which is undoubtedly present. In order to evaluate such mixtures and also to determine the relative value of each individual as a stain, it was necessary to prepare each individual free from its homologs. This involved the preparation of certain intermediates and the purification of others. Each of the four lowest members of the series was prepared by two distinctly different methods, carefully purified and some very interesting spectrophotometric data obtained.

Use of Buffers in the Determination of Color by Means of Titanium Trichloride. II. O. L. Evenson and R. H. Nagel.

This paper presents work done since a previous report on this subject. Suitable buffer salts have been determined for all the titratable food colors. It has been found possible to use either sodium citrate or sodium bitartrate in all cases. Other salts which may be used are also given.

Nature of Interaction Between Hydrous Oxides and Mordant Dyes. II. Neil E. Gordon and George R. Seidel.

Products have been prepared under varying conditions in order to determine the nature of the interaction which takes place between the hydrous oxides and mordant dyes. The indications are that the interactions are chiefly, if not wholly, chemical.

The Magenta Series: II. The Preparation and Spectrophotometric Study of Some Higher Basic Members. John T. Scanlan.

The necessary intermediates were obtained by purification of commercial products and by synthesis and from them were prepared four of the higher homologs of the ordinary magentas. Wherever feasible each was prepared by two distinctly different methods. These new dyes should prove of value as stains because of the differences in physical and chemical properties due partly to the additive and partly to the constitutive effect of the additional methyl groups. Some very interesting observations were made upon them by means of the spectrophotometer.

A Survey of the Coal-Tar Dyestuffs in Use in the Lake Industry Today. T. A. Martone and Henrietta C. Wood.

1. Azo Colors:
   (A) All the important colors in use at the present time will be considered under this head and the special treatment that is necessary to make it possible for the lake manufacturers to obtain bright lakes possessing good tinctorial strength.
   (B) Manufacture of azo pigments from intermediates which are made directly by the lake maker, such as meta nitro para toluidine, R-salt, beta oxy naphthoic acid, and Tobias acid. A description of the remarkable purity necessary and of the effects of impurities on the colors developed from these intermediates.
2. Basic Colors:
   Precipitation with tannic acid, tartar emetic, phosphotungstic acid, etc., and the methods of obtaining good light fastness.
3. Vat Dyestuffs:
   (A) Adaptability of series because of their non-bleeding properties in oil, lacquer and alcohol, and fastness to light, acid and alkali for use in paint, lacquer, printing inks, rubber, wall paper, coated paper, and cold water paints.
   (B) Method of preparation for lakes and tinctorial value.

On the Evaluation of Lake Pigment Colors. E. R. Allen.

Methods of testing lake pigment colors concern not only the pigment manufacturer but the supplier of raw materials and consumer as well. Many difficulties present themselves, the more important of which are:

(a) Definite standards do not exist in the trade.
(b) Chemical methods and goal of chemical purity are of only secondary importance, i.e., different from dyestuff industry.
(c) Use of a variety of accessory substances such as substrata and dispersing agents complicate the matter of chemical viewpoint even further.
(d) Uses of pigments are extremely varied because

of consuming industries involving diverse procedures, e.g., linoleum, paints, lacquers, printing inks, coated textiles, coated paper, and plastics. Requirements of these industries naturally vary widely.

The problem of lake pigment standardization is not hopeless, however, and the progress that has been made indicates the desirability of further effort in this direction.

The more important qualities that require evaluation are: (1) tinctorial qualities; (2) light fastness; (3) bleeding. In the list of tinctorial properties the hand mull out in an oil vehicle and extension with zinc white form a generally accepted basis for commercial evaluation. Supplementary methods are necessary from time to time and their use will probably increase as requirements of the industry are more clearly understood.

Light fastness is extremely difficult to evaluate since this quality is influenced not only by the quality and intensity of light but also by the thickness of the film, the degree of humidity, and the nature of the vehicle, all factors extremely difficult to reduce to absolute units. Despite its artificial nature the value of the fadeometer as compared with outside exposures should not be overlooked for the reason that it represents the nearest approach at the present time to controlled conditions and from it relative values can be obtained. From these relative values, outside exposures can be more satisfactorily planned. The consumer of pigments, however, must rely chiefly on exposures simulating as nearly as possible the conditions under which the finished product is to be used. Absolute values are not possible at the present time, but continued activity in this important field will probably bring advances in this direction.

Bleeding is necessarily tested by conditions simulating those in actual use, whether in oil, water, lacquer solvents, paraffin, fats, and spirits. While chemical methods cannot be widely used in the testing of pigments, the chemical nature of product being tested should not be lost sight of. For instance, a pigment dyestuff such as Tolindine toner will show little variation in bleeding properties or light fastness under different methods of processing. In the case of precipitated lake pigments, either from acid or basic dyestuffs, this is not true, since methods of processing may influence both these qualities. Likewise, strictly non-bleeding pigments will be formed in the greatest frequency in the precipitated lake pigments, i.e., in the metallic derivatives.

While progress has been made in this field, there is certainly no justification for complacency since much more remains to be accomplished than has been done so far and continued co-operation between dyestuff manufacturer, pigment manufacturer, and pigment consumer is necessary.

The Isoelectric Point and Its Relation to Textile Chemistry. T. G. Hawley and Milton Harris.

The isoelectric point is the resultant of opposing acidic and basic qualities of an amphoteric compound. Methods for determining the isoelectric point are based on the fact that at the isoelectric point the osmotic pressure, viscosity, solubility, migration of particles in an electric field, conductivity, swelling, and combining power are all at a minimum. The isoelectric points of silk and wool have been reported on the acid side. Silk is unique in the preponderance of acid groups in its structure and many of its chemical and physical properties are easily explained in the light of its acid nature.

A Rapid Method for the Quantitative Estimation of Amaranth and Tartrazine in a Food Color Mixture. O. L. Evenson and R. N. Nagel.

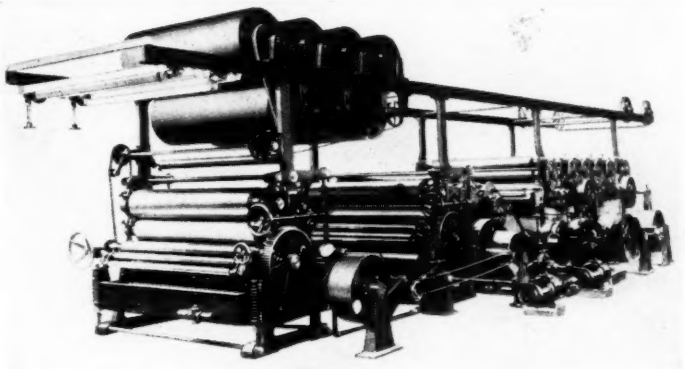
A quantitative estimation of certain food dyes, especially Amaranth and Tartrazine, which have practically the same solubility in organic solvents and, therefore, cannot be separated by the extraction method, may be made by employing selective reduction. In a mixture of Amaranth and Tartrazine, the Amaranth is reduced by ammonium sulfide, leaving the Tartrazine, which is then estimated by means of titanium trichloride. The spectrophotometric method is also discussed.

Translation of the Various Color Languages Into One Another. I. H. Godlove.

The advantages of definiteness, freedom from personal vagaries, and precision of physical measurements, can be combined with the direct knowledge of "how a color looks," by developing a large number of color samples in a system of standards exhibiting even gradations of the three true color variables, calibrating these carefully once for all by physical measurements, and directly comparing all colors with these, interpolating visually where necessary. The results can be translated from one to another of the methods of specification (spectral curves, monochromatic or trichromatic analyses, or other methods), by means of data and methods already worked out in great detail. The intermediate step in all these transformations is trichromatic analysis; expression in terms of three arbitrarily chosen primary stimuli. Methods and data have now been worked out for the interconversion of trichromatic analysis and the three psychological color variables, brilliance, hue, and saturation.

Pharma-Chemical Corporation recently announced the election of Mr. Charles M. Richter as president of the corporation. Mr. Richter has been a member of the board of directors and has been in intimate touch with the affairs of the corporation since its inception. Mr. Frederick Diehl, Sr., was elected secretary. Mr. Diehl has also been with the organization from the time it was founded.

New Machinery



Chainless Mercerizing Machine

The illustration shown above is of the latest type Benninger Swiss chainless mercerizing machine. Among the advantages claimed for this new mercerizer are: increased production, saving of space and operating cost, and uniform mercerization over the entire width of the goods.

In brief, the machine consists of a three-roll impregnating or padding box, a stretching device, and a washing and caustic recovery apparatus.

Anyone interested in mercerizing would do well to examine the model of this machine at the office of A. W. Buhlmann, at 200 Fifth Avenue, New York. The interest shown by all who have viewed the model proves that everyone retains, to some extent, his childhood interest in toys.

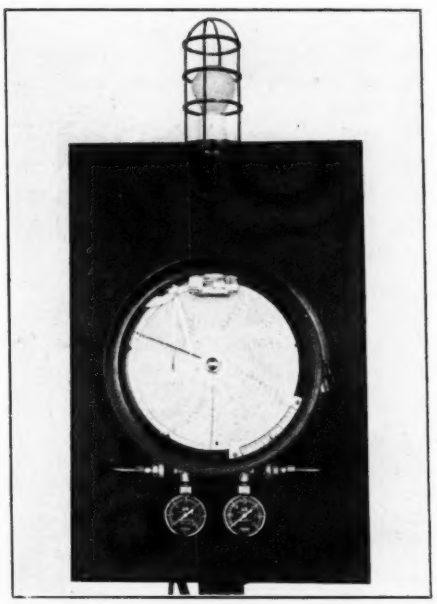
The miniature machine, built on a scale of one to five, though truly a toy, has all the structural details of the plant-size machine. Observation of this model gives a comprehensive view of the theory of chainless mercerizing and at the same time shows to good advantage the improvements made in the Benninger machine.

Foxboro Dye Tub Control

The dyeing industry should show an unusual amount of interest in the new dye tub control system recently completed by The Foxboro Company of Foxboro, Massachusetts.

The new Foxboro control fits the modern trend in piece dyeing. This controller takes the pre-heated dye water being delivered to the machines, raises it to the exact temperature needed and holds it at this temperature for a definite time predetermined by the dyer. When the time is up the instrument shuts off the steam and turns on a signal light.

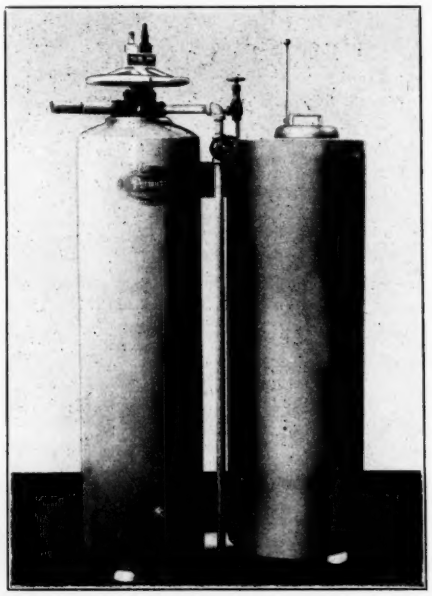
The illustration above shows the complete Foxboro control panel. In addition to the temperature control unit the instrument is equipped with a time scale and a movable index. The operator sets the time index to the points representing the total time for the dye operation. At the end of the period the control shuts off and the signal, shown in the picture, lights. If the operator finds that the batch requires longer time he merely sets the index for the increase in time and the steam is automatically turned on, the light extinguished and the process



continues until the end of the period. The operator always has before him, as a guide, a complete record of each operation in time and temperature. The possibilities for matching shades with this new control system are unlimited.

Small Size Water Softener

The Permutit Company of New York City, are to exhibit for the first time at the Southern Textile Exposi-



tion, a new model of the Permutit Water Softener. This softener is suitable for use in small textile mills as well as for special applications in larger plants.

For example: in the making of full fashioned hosiery, silk as it comes from the throwster is usually dry and in skeins. It must be wound on cones or bobbins, and to avoid its becoming brittle must be moistened. This is usually done with an emulsion of a special oil and water.

Soft water is said to possess many advantages in making up this emulsion. It allows it to form more easily, conserves oil and will not deposit mineral impurities or gummy masses on the silk.

These new Permutit Water Softeners can be obtained in a number of sizes. The illustration shows one of the small softeners with an attached saturator.

The Densometer

The need for a scientific means for measuring the compactness of a fabric structure has long been felt. The usual physical tests have fulfilled a useful purpose, but they have distinct limitations. The "Densometer," as manufactured by W. & L. E. Gurley of Troy, New York, is an instrument which measures the density of the material tested, in terms of the number of seconds required for 100 cc. of air to pass through its interstices, under constant pressure.

The "Densometer" is made in two sizes: one having a standard orifice of 1 square inch and the other having a special orifice of ¼ square inch. The standard orifice is for use with paper, and coated or heavily sized textiles. The special orifice is for use with more porous fabrics.

BOOK REVIEWS

Practical Color Simplified. *By William J. Miskella, M.E. Published by the Finishing Research Laboratories, Inc., Chicago. 20 Figures, 6 Colored Plates. 114 p. Price* $3.50. *Vol. I of the Practical Finishing Series.*

This volume is essentially a handbook on lacquering, enameling, coloring, and painting, with special attention to color mixing, choosing, harmonizing, matching, lighting, testing and designation.

Although the author has chiefly in mind coloring and finishing for decorative purposes, rather than the dyeing and finishing of textile materials, the sections dealing with the fundamental principles of color, color choosing, color mixing and color harmony are directly applicable to textile coloring. The chapter devoted to color testing discusses quite fully the application of the fadeometer and weatherometer.

The closing chapter, entitled Color and Business, will be found of considerable interest at the present time, when industry is endeavoring to introduce color into so many different manufactured articles.

Five Years of Research in Industry. 1926-1930. *A Reading List. Compiled by Clarence J. West. 92 p. Published by National Research Council, Div. of Engineering and Industrial Research, 29 West 39th St., New York City,* 1930. *Price* 50c.

The primary purpose of this bibliography is to supply references to articles which provide answers to some of the following questions:

1. What are the conclusions of America's leaders of research?
2. What practical results are they achieving in their laboratories?
3. What is their opinion of co-operative effort in research as contrasted with individual effort?
4. How should the research department be organized?
5. What is the philosophy and method of operating research laboratories in specific industries?

A secondary purpose is to indicate those fields of research in which little or no work is being done.

The references are classified under nearly one hundred different headings. Among these headings are included: Bleaching, Dyes and Dyeing, Textiles, Cotton, Wool, Silk, and Rayon. This book will make a valuable addition to the library of every research laboratory.

Year Book of National Association of Cotton Manufacturers. *The* 1930 *edition of the Year Book of the National Association of Cotton Manufacturers, the reference work of the industry, is being distributed to mill executives in the cotton manufacturing countries of the world.*

The current issue contains all of the features which have made the work known as the most comprehensive compilation of data of interest to the manufacturer avail-

able. At the same time, through rearrangement of statistics and other material, the volume has been made slightly smaller and more compact. The conservation of space has been made with no sacrifice as to size of type and legibility and has resulted in making it easier to find the information desired.

Among other things, the book presents the cotton manufacturer a detailed picture of the particular parts of the cotton crop in which he is interested, according to Secretary Russell T. Fisher.

"Statistics from the most recent census available include more subdivisions by classes of fabrics and divide the production of cloth into groups of fabrics with yarn numbers averaging 40s and below and above 40s."

The present volume is believed to include practically all of the authentic information about the industry that manufacturers and other interested persons might want. Since the publication of the first Year Book in 1918 changes have constantly been made, new tables added in the statistical and technical sections and revisions made to keep the data up to date.

Techno-Dictionary. *By Hubert Hermanns. Published by the author in Berlin.* 1929 *Second edition—pages* 432.

This dictionary has been compiled for the convenience of readers of technical periodicals. The author has endeavored to collect the largest possible number of terms found in reading foreign and technical periodicals and books. Approximately 7,000 words are included in each of the three parts which are as follows:

Part I: German, English and Italian; Part II: English, German and Italian; Part III: Italian, German and English. It is thus possible for the user of this dictionary to quickly translate these 7,000 words from any one of the three langauges into the other two. It should prove a great help to the engineer and business man in reading German and Italian literature.

General Dyestuff Releases

Coloresine DK, a new thickening agent, is of general interest for printing, particularly for vat colors. It is said to be soluble in hot water and alkali. I. G. 384.

Fast Blue BB Salt and Fast Blue RR Salt, the 40% color salts of the respective bases, yield on Naphthols of the AS range the same shades as their respective bases. I. G. 386.

Supramine Yellow 3GL, a new acid dyeing yellow, produces from a Glauber's salt—sulphuric acid bath bright greenish yellows. According to the circular, it has very good fastness to light, levels well, has good solubility and is of good fastness to water, salt water and washing. I. G. 388.

Indanthren Golden Yellow RK Double Paste is dyed according to the IK method to produce reddish yellows on cotton and vegetable fibers. It is recommended for its great brilliancy, its good fastness to light and its fastness to washing and chlorine. I. G. 395.

Color Faults in Finished Materials

How to Diagnose Them

By F. L. Goodall, M.Sc.
Geigy Colour Co., Ltd.

THIS paper is not intended to deal with faults in actual dyeing processes, but rather to discuss faults which arise before and after dyeing, and for which a dyer is frequently, though wrongly, held responsible. The remarks deal mainly with wool, but some of them have other applications as well.

Wool and cotton are dyed in many forms, in the loose state, in the sliver, the yarn and the piece, and at every dyeing point it has almost always had some chemical treatment prior to dyeing, and again in almost every case it has to stand a chemical and physical treatment after dyeing.

There are innumerable conditions under which a color might fail, and the first thing to do in tackling any fault, when the color itself is obviously not to blame, is to get as many particulars as possible with regard to it, for the slightest detail might be valuable in determining the cause. The next thing is to consider all the varying treatments which the goods have had, and next to make experiments on small samples with the object of reproducing the fault, for if by certain methods a fault can be reproduced it is almost certain that the original fault would be caused by the same or similar methods. Even though cases of color failure are almost always brought about by treatment involving chemical action, investigators are not always aware that any particular treatment involved chemical treatment at all, e.g., it was not generally known that many tailors, when pressing clothes, soaped the garment.

All normal processes in wool involve the use of alkali, and the generally practised method of removing this alkali is by washing the goods in water, but it cannot be completely removed except by prolonged washing, so that all woolen goods are slightly alkaline unless special precautions have been taken to neutralize any residual alkalinity by the addition of formic or acetic acids or ammonium salts to the washing off water after scouring and milling, unless the last manufacturing process is the dyeing, in which case the goods would be slightly acid as a result of being dyed from an acid dyebath. Practically all piece-dyed goods are, therefore, slightly acid, while slubbing or loose wool dyed piece-goods, such as all patterned goods, are slightly alkaline.

Wool containing alkali, if dyed while still wet, will dye a much fuller shade than wool free from alkali. The importance of the complete removal of alkali throughout a batch of goods and its effect on level dyeing is obvious. If an individual piece is not thoroughly washed off and still contains alkali, no great harm is done, provided the alkali is evenly distributed, and the goods are either dried or dyed immediately, but if they are left lying about in a wet state, the exposed edges dry slightly and the liquor creeps from the unexposed parts to the exposed parts

carrying soda with it, until finally there is a high concentration on the centre of the batch where there has been no exposure. Obviously such goods dye unevenly and in many cases the exposed portions dye darker than the rest, but sometimes owing to the attacks of bacteria they dye lighter.

It is possible to make even fast chrome colors stain by scouring with alkali at too high a temperature, but in the dyeing process the goods are subjected to a higher temperature than in any scouring machine, and if alkali is not completely removed before drying—although the amount left might be very small—the concentration of the alkali solution in the goods becomes higher as drying proceeds, and the combined effect of the high temperature in the dryer and the strong alkali solution then in the cloth causes the goods to be stained and off shade.

Another danger is that all goods are steam blown, and if the cloth contains alkali it is very possible that there would be stained or off-shade pieces. Thus residual alkali left in goods might lead to unevenness in subsequent dyeing by its own action, and in the case of goods already dyed might cause staining and alteration of shade. It is also responsible in most goods for promoting the development of bacteriological action and the development of one form of mildew and also for the development of sulphite faults. In every case the dyer is blamed for faulty dyeing and faulty dyestuffs, and in about every case the scourer is to blame. The use of ammonium sulphate as a remover of alkali has been recommended, but for obvious reasons it is not so efficient as adding a volatile acid which evaporates off on drying the goods. Incomplete removal of alkali is the commonest cause of apparently inexplicable color failure from the manufacturing point of view. Exactly similar faults are caused by it in the ordinary domestic laundering. For instance, there are many complaints about streakiness after washing woolen jumpers. When rinsing woolen goods, plenty of warm water is required, and the garments should then be dipped in weak acetic acid before finally drying, after which they can be dried in very hot places without any fear of the color running.

Sulphite faults are closely related to, and often dependent on, a previous residual alkali fault. The Geigy Co. have devised a simple test which takes the form of spotting the test pattern with four solutions containing different relative proportions of SO_2 and alkali, and leaving the spots to dry for 12 hours. In view of the fact that nearly all woolen goods, except those which go straight from the dyehouse into finished articles, are slightly alkaline, it follows that in an atmosphere containing SO_2, even in small quantities the alkaline goods will gradually absorb SO_2 from the surrounding atmosphere, and eventually the relative proportions of the alkali and SO_2 will reach the stage at which azo-sulphite formation proceeds, and a fault is produced, with a change of shade wherever the goods have been in contact with the air. This happens with every class of dyed fiber.

There are other carriers of SO_2, or sulphite apart from the atmosphere, which might give rise to similar faults. In the case of a two-fold yarn, in which one twist was stoved, the SO_2 contained in the stoved twist might completely alter the shade of the colored twist in contact with it, or of an adjacent bundle of yarn during storage. Then there is the case of sulphite formed by oxidation of residual sulphur and sodium sulphide left in dyeings made with sulphur colors, leaving cuttle bars at intervals across the piece, wherever the cloth had been exposed to air while in storage.

By far the commonest cause of sulphite faults lies in the packing paper used in packing goods in warehouses, shops, etc. Wood pulp is generally freed from lignin by extraction with calcium bisulphite solution, and when such pulp is made into paper, some sulphite is always contained by the paper. Linen and cotton rags, etc., used for making fresh paper are bleached with bleaching powder, and hypochlorite and sulphites are added as antichlors. This presence of sulphur in paper does great damage to dyed goods if left parceled up for any length of time. In order to test thoroughly the fastness of a dyed pattern to SO_2 under all conditions, it is necessary not only to make the ordinary stoving test and the Geigy sulphite test, but also a further more drastic test involving the use of either the sulphite solutions hot, or a hydrosulphite solution.

Hydrosulphite could and would reduce other classes of colors besides azo colors, and it might reasonably be inferred that active sulphite would have a similar action. Only such colors as are exceptionally resistant to reducing agents are quite unaffected by active sulphite. The fastest are those which are not, or hardly, reducible with hydrosulphite—Eriochrome Red B, Anthracene Browns, Alizarine Cyanines, etc., and the next fast are those colors which although reduced by hydrosulphite are re-oxidized by air alone, such as Brilliant Wool Blues, Erio Fast Fuschine BL, Rhodamine B, vat and sulphur colors.

All the faults mentioned due to SO_2 could arise, and often do, during storage in the dark. Exposure to light in general has nothing to do with the fault. The azo-sulphites when formed are not so fast to light as the parent dyestuffs. Even if only a small proportion of the dyestuff on any pattern is converted to azo-sulphite, the pattern will fade quicker than it should do.—*Textile Record.*

**Lecture at a joint meeting of the London Section of the Textile Institute and the Society of Dyers and Colourists.*

Mr. John H. Moran, active partner of the firm Ellis Jackson & Co. for the past twenty-three years, recently announced its dissolution. He will, however, continue in the chemical, oil and dyestuff business under the new firm name of John H. Moran & Co., Inc.

The Fireproofing of Cotton Fabrics

THE loss of life and damage to property directly due to the inflammatory nature of cellulose materials have from the earliest times stimulated the search for methods of coating or impregnating these substances with a view to protecting them from the influence of flame. As long ago as B. C. 83 Claudius describes in his Annals how the wooden storming towers used by Aulus Cellius at the seige of Piræus were protected from the fire-tipped arrows of the garrison by being painted with a solution of alum, thus superseding the use of freshly skinned ox-hides, the employment of which entailed considerable disadvantages. In 1638 Sabattini recommended that the paint used for theatrical scenery should contain a certain admixture of clay and plaster-of-paris. Montgolfier impregnated the fabric of his fire balloons with a solution of alum to protect them against premature ignition; and Arfrid in 1786 suggested the use of ammonium phosphate for fireproofing theatre curtains.

Gay Lussac, the famous French scientist, instigated by Louis XVIII., was the first to carry out, in 1820, a systematic investigation on the fireproofing of fabrics. He concluded that the most effective salts were those which had a low melting-point and covered the surface of the fabric with a glassy layer, or which gave off non-inflammable vapors on heating. This work forms the basis of the generally accepted explanations of the action of fireproofing agents. And on this basis, from 1735 onwards, one substance after another has been the subject of patent claims, the later tendency being towards the production of complicated mixtures of substances, the exact function of the ingredients of which is not readily apparent.

In the second report of the Fabrics Research Coordinating Committee (H.M.S.O., 5s.), J. E. Ramsbottom and A. W. Snard give a list of fireproofing substances which they have compiled from technical journals, textbooks, and the patent literature. They point out that there are two types of fireproofing processes: (*a*) The process which deposits soluble salts on the fabric, easily removed by washing; and (*b*) the permanent process in which an insoluble compound is precipitated on the fabric. The soluble fireproofers regarded as the most efficient include sodium tungstate, ammonium phosphate, ammonium sulphate, borax, ammonium chloride, sodium silicate, and zinc chloride.

In the case of permanent fireproofers the fabric is impregnated with a soluble salt, dried, and passed into a second salt solution, which by double decomposition precipitates an insoluble compound on the fibers. Perkin (E. P. 9695 and 23,557/1901) claimed the use of a solution containing sodium tungstate and aluminium acetate, with enough acetic acid added to keep the aluminum tungstate in solution. On drying the fabric the acetate acid is volatilized, and the insoluble aluminium tungstate is deposited. Numerous other insoluble borates, tungstates, phosphates, and silicates have been put forward as permanent fireproofers, but the authors of the report consider that these owe their apparent fireproofing qualities largely to the soluble salts retained as a result of imperfect washing. Hydrated stannic oxide has been the subject of many researches, particularly in connection with flannelette. Perkin's Non-Flam flannelette was prepared by first impregnating with sodium stannate, dried, and finally passed into ammonium sulphate, which precipitated stannic oxide on the fiber. A noteworthy property of stannic oxide and hydroxides of aluminum, zirconium, titanium, zinc, and magnesium is, that although they may prevent flame propagation under certain conditions, they do not prevent destruction of fabric by flameless combustion.

Very little work has been published on the effect of fireproofing agents on the strength of fabrics. Hübner and Malwin ("J. Soc. Chem. Ind.," 1923, 66 T) investigated the action of 1% solution of fireproofing salts on the strength of cotton fabrics. They showed that a decrease both in tensile and ripping strength took place in many cases.

For their own investigations on fireproofing, Ramsbottom and Snard employed strips of cotton cloth 18 in. long and 1 in. wide, which were suspended inside a box perforated top and bottom and provided with a glass door. A flame was applied to the lower end of the strip, and the rate and character of the combustion were noted.

From among the large number of fireproofers examined, ammonium sulphate, ammonium bromide, the molybdates of ammonium and sodium, sodium tungstates, stand out as pre-eminently effective when applied in comparatively small amounts. Neither borax nor boric acid gives efficient fireproofness when less than 60 grms. or so are applied to 100 grms. of cloth; but when mixed together in the proportion of seven of borax to three of boric acid, even 10% of the mixture suffices to render the fabric practically non-inflammable. No insoluble fireproofer was found giving anything like the same degree of protection at a concentration of less than 30%. It seems probable that the efficiency of the mixture of borax and boric acid is due to the fact that whereas both borax and boric-acid solutions, when allowed to evaporate on cloth, deposit their contents in the form of minute powdery crystals, the mixture of borax and boric acid evaporates to a glassy homogeneous coating, which prevents free access of air to the heated cellulose, and thus hinders free combustion. This alteration in the behavior of the two ingredients of the mixture may be due to the formation of an acid borate of sodium. Ordinary borax has the

formula $Na_2O2(B_2O_3)10H_2O$. The addition of three parts of boric acid to seven of borax can be represented approximately by the equation—

$$Na_2O2(B_2O_3)10H_2O + 2H_3BO_3$$
Borax. Boracic acid.
$$= Na_2O3(B_2O_3) + 13H_2O.$$

Some of the soluble salts found to be efficient fireproofers have the serious disadvantage that on storage at 40° C. there soon shows itself a marked diminution in tensile strength. Thus cloth impregnated with ammonium sulphate went down in tensile strength after 70 days from 77 lbs. to 54 lbs., and after 300 days to 21 lbs. Ammonium phosphate under similar conditions had fallen to 43 lbs., while borax still gave a figure of 75 lbs., and boric acid 63 lbs. Exposed to sunlight under glass for 200 days, deterioration was much more marked in the case of the soluble fireproofing agents, while insoluble substances such as aluminium hydroxide caused the treated cloth to remain stronger even than that not treated at all.

The report ends with a detailed examination of the action of borax, boric acid, and mixtures of the same, on cotton cloth under various conditions. It is shown that the mixture of the two bodies is in every way superior to that of either body used alone. About 6% of a mixture containing from 30% to 40% of boric acid with from 70% to 60% of borax gives better results than any proportions outside these limits. Cloth exposed to a temperature of 140° C. for four hours lost 6% of its tensile strength, a figure unaltered by the application of 4% of borax or 7% of the mixture, whereas 7% of boric acid had lowered the strength by 95%. Untreated fabric when heated in absence of air until carbonized was found to evolve 31.9% of its weight as inflammable gases and tarry matters, whereas fabric treated with borax or boric acid alone evolved only 23% of inflammable matters; and with the mixture of borax and boric acid this figure was still further reduced to 18.7%. Untreated cloth began to give off inflammable gases at 317° C., whereas with 6% of the mixture the products evolved would not take fire even at 400° C. It is probable that the difficulty of igniting cloth that has been fireproofed with the borax mixture is due to the two facts cited above. The amount of volatile inflammable matter is reduced, and it possesses a lower degree of inflammability, so that it becomes incapable of propagating a flame. The action of the fireproofer appears to be essentially chemical, although there is no evidence of any action of the borax mixture on cellulose at ordinary temperatures. Further advantages attaching to the use of this material as a fireproofer are that in the small proportion necessary for protection of the fabric there is no appreciable effect on the handle of the cloth; and, unlike some of the other fireproofers investigated, it has been shown not to promote the growth of destructive micro-organisms. Above all, it is cheap, and its application to a fabric is simple. It may, therefore, be regarded as one of the most suitable soluble fireproofing agents for cotton.—*Textile Manufacturer.*

Technical Notes from Foreign Sources

Dyeing Exactly According to Sample

Zeits. f. Farben-Ind. 1928/29, *p.* 253.—The General Association of German Dyeing and Finishing Industries has sent out a circular of general interest, which should contain some hints of value to the American industry.

There is hardly any other condition of delivery, the circular says, which gives rise to so many misunderstandings and controversies between customer and producer as the demand "Dye exactly according to sample." To anyone who understands the very many varied possibilities of going wrong, and the variable nature of the criteria of exact matching, the difficulty is perfectly clear. The following points will explain why an exact match is frequently absolutely impossible, and why in some cases an exact match is really for the interests of the customer only within certain limits.

1—The Sample

a—The size of the sample is frequently of such small dimensions that the desired color-tone cannot be recognized and matched except with a certain degree of hesitation.

b—Dyed samples are frequently taken from material which does not offer a simple means of comparison with the color-tone of the textile goods; e.g., carpet goods, wood.

c—Even samples of textile material are not suitable, if they consist of a fiber different from that of the goods required to be dyed; e.g., woolen samples for cotton goods, artificial silk samples for linen goods. In part, the shade varies as the sample is viewed perpendicularly or slantwise or nearly across, and, in part, the nature and degree of luster makes a difference in the color-tone.

d—If the sample is of the same fiber as that of the goods to be dyed, nevertheless, the difference in quality, the mode of production, and the antecedent treatment give rise always to differences of opinion regarding the tone; e.g., hard twist and open yarns, thickly and loosely woven goods, lustrous wool yarn and matte artificial wool, mercerized and unmercerized cotton, velvets and smooth weaves, even different runs of the same goods, different fullings or carbonizings, as well as acid-dyed wool-samples for goods to be chrome-dyed, etc.

e—Samples taken from the end of the run from the

loom often do not display the color-tone of the whole piece adequately; they are perhaps frayed or otherwise damaged, and should therefore not be used as samples.

f—Finishing processes, as calender or mangle pressing, hot-pressing, etc., as well as finishing agents used, influence the color-tone to a considerable extent, and obscure it.

2—The Light

a—A distinct difference between sample and finished goods is often to be noticed by artificial light, even though the two correspond exactly in good daylight.

b—Even by daylight, differences in color-tone are noticeable, at least under undiffused "white" light. Thus, differences appear between sunlight, skylight, daylight reflected from a red brick wall, or from the green of trees or shrubs.

c—The dyer must be assured that the customer is not to any degree color-blind, as this would obviously lead to unavoidable differences of opinion.

d—Fluorescent dyeings are extremely difficult to match.

3—Fastness of Dyeings

In textile dyeings, fastness is to be regarded, not as absolute, but always as only comparative. There is not a single dyestuff which withstands absolutely all the influences to which textile materials may be exposed. On this account, even the sample furnished for matching does not always possess the same tone which is originally had; so that, if the goods are dyed according to this already altered color-tone of the sample, the match is frequently unattainable even with the method used for the goods from which the sample was taken; the match has to be obtained, perhaps, through use of other dyestuffs with varying fastness-properties. Consequently, the goods finally possess the desired color-tone, but this, under the same conditions which affected the original sample, will alter in a different manner, and will not satisfy the fastness-requirements which may quite reasonably be placed upon it. Since, in shading, very small amounts of well-levelling dyestuffs, which are for the most part less fast, are needed to correct the tone, the danger that they will soon fade or alter in their own tone, and so alter the whole tone, is very great.

4—Suitability of Dyestuffs

In spite of the enormous choice possible between dyestuffs of the different classes, now offered by the different color-makers, yet the selection in certain suitable classes is often not of sufficient range, to obtain each color-tone exactly true to sample. But it is not fair to the customer, usually, for the dyer to add a dyestuff of a different class, in order to attain a tone otherwise difficult to match. Thus, alizarine dyestuffs and the much-favored Indanthrenes do not allow all color-tones to be obtained with them, which can be obtained with dyestuffs of other classes. In addition, it is, with the alizarines and Indanthrenes, practically very difficult, and at times actually impossible, to match any tone demanded; in addition, the kind of material and the way in which it has been worked up, influence the final tone. Since the trade-mark "Indanthrene" is protected by law, it is not allowable for the dyer to obtain the tone demand with other dyestuffs, if the Indanthrenes are specified.

The difficulties which are encountered in the effort to attain a prescribed color-tone are by no means exhausted by the above items, but what has been said may be sufficient to make possible a better understanding between customer and dyer.

As dyeings exactly true to sample are in many cases really not necessary, the condition "dyed exactly according to sample" should be laid down only in case of absolute necessity. This more limited use of the too customary phrase would then have as a result, that the phrase would be taken more seriously when used, and would not be regarded as simply a stock phrase.

Since an exact shading of a tone usually costs the dyer much time, labor, material, and money, the customer, when using the phrase in question (and this is especially the case with small orders), must be ready to pay a correspondingly higher price, for the figures commonly quoted for dyeing are not reckoned upon a painfully exact duplication of shades or tones.

If the customer demands a special fastness as well as the highest correpondence in shade, as in the case of Indanthrene dyeings, he must be prepared to meet with certain variations in tone, even with non-level dyeings, in the finished goods, for if the dyer is compelled, as may easily be the case, to carry out dyeings more than once upon the same goods, the appearance, the consistency, and the value in use may sometimes suffer.

The customer is also recommended to "go easy" (leicht anzulegen) as regards the severity of his standard, even in cases in which his requirements as to exact matching are not extremely high. Since in most cases the dyer knows from experience what standards of fastness are to be imposed for certain purposes, he will use those dyestuffs which in his judgment are best suited for the purpose in question. As far as is possible, therefore, the customer should state the purpose for which the goods are to be used. But if the dyer is forced to shade the goods somewhat, in order to match the sample, there is danger that he may not be able to attain the prescribed color-tone on account of the fastness-standard for which he is also working.

Since there is no general agreement as to the allowable limits of variation in color-tone, the customer should consider such slight variations in a reasonable way, when the order has prescribed "dyeing exactly according to sample."

Vat Dyestuffs of Thio-Indigo Series

German Patent No. 450,799—*I. G. Farben-Ind. A.-G.*—A series of very fast dyestuffs, of shades ranging from red to violet, is produced by the condensation of the 2-anils of nuclearly-substituted 2-3-diketo-dihydro-thionaphthene with either nuclearly-substituted aryl-thioglycol-1-carbonic acids or the acyl-oxy-thio-naphthenes produced from them by condensation with acetic anhydride. The fundamental condensation is carried out with or without the use of diluting media. Six examples are given.

The So-called "Praestabitoel" Process (Vat Dyeing)

K. Pomeranz—Monatsch. f. Textil-Ind. 45, 85 (1930).—This process, which has attracted considerable attention in Germany, consists of impregnating the goods with an extremely fine suspension of the dyestuff in a solution of Praestabitoel, a proprietary compound, drying completely, and passing the goods into a developing bath of alkaline hydrosulphite, the dyesuff being thereby reduced, dissolved, and fixed upon the fiber. The goods are then soaped, washed, and finished. The general process has long been known (20 years), but the use of the oil in question as a dispersing agent has greatly improved the process, it being the best of all highly sulphonated oils. By this phrase we understand oils which have been treated with such material as fuming sulphuric acid or chlorsulphonic acid, the products from this vigorous sulphonation then being actually true sulphonic acids of the fatty carbonic acids of the oils employed, according to the view of Prof. W. Herbig.

Pomeranz's view of the matter is, that the name "Praestabitoel Process," the title under which the method is being quoted, is essentially a bit of propaganda in favor of the firm which manufactures this particular oil; that the makers have a perfect right to call their product (which is of unknown constitution) by that name, but the process itself should not be so designated, for there are other oils on the market which, while not so satisfactory as the one under discussion, still perform satisfactory service. Such a viewpoint may seem to some to be rather personal, but it is a matter of fairness to everyone that a name be exactly and fairly applied. The short article closes with a reminiscence of a personal sort, of a proposal by Axmacher to call the substantive dyestuffs by the general title of salt-dyestuffs, because they are universally applied from some sort of salt-bath. P. adds a proposal made by him at the time to extend the principle by giving Alizarine Red a name, derived from a now antiquated method of dyeing Turkey Red, which one would hardly venture to translate from the German—but indicating the lengths to which one would have to go if we proceeded logically from an ill-founded premise. To a thoughtful scientist of good conscience, such a procedure rather justifies Pomeranz's complaint.

Green Sulphur Dyestuffs

German Patent No. 459,297—*Gesellsch. f. Chem. Ind.* (*Basle*)—German Patents Nos. 135,410 and 162,156 cover the production of green sulphur dyestuffs by treatment of certain leuco-indophenol-sulphonic acids with alkali polysulphides in the presence of copper. The products are not fast to washing or boiling. An advance is noted in G. P. No. 259,519, but the fundamental material, the indophenol from o-o'-dichlor-p-aminophenol and ethyl-alphanaphthylamine, is not easy to prepare.

The present patent covers the use of rather simpler, more easily synthesized fundamental substances. Thus, from the indophenol formed from ethyl-alphanaphthylamine and p-aminophenol, a sulphur dyestuff is obtained which dyes cotton a pure green, without after-treatment, and fast to boiling alkaline soap solutions. It is, in the dry state, a dark-blue powder of coppery luster, dissolves in concentrated sulphuric acid with a blue, and in dilute hot sodium sulphide solution, with a greenish-blue color. The indophenols mentioned are first converted into sulphonic acids by treatment with alkaline sulphites before the fusion with poly-sulphide in presence of copper.

Azo (Azoxy?) Dyestuffs

German Patent No. 446,495—*I. G. Farben-Ind. A.-G.*—The products mentioned are produced by partial reduction and consequent linking together (as in the reduction of nitrobenzene to azoxybenzene) of two molecules of azo dyestuffs prepared by coupling diazotized sulphonated p-nitroamines, or their derivatives, to suitable second components. Thus, the simple dyestuff formed by coupling diazotized p-nitroaniline-o-sulphonic acid to salicylic acid, on alkaline reduction, gives a copper-brown dyestuff, consisting of two molecules of the original mono-azo dyestuff, linked together through the nitrogen of the nitro-groups. This particular product forms a soluble chromium compound if treated according to G. P. No. 282,987, and this chrome dyestuff is a substantive dyestuff, which can be fixed with great tenacity by treatment with alkali or by steaming.

Azo Dyestuffs for Acetate Silk

German Patent No. 452,213—*I. G. Farben-Ind. A.-G.*—The dyestuffs here proposed for acetate-silk are mono-azo dyestuffs, whose first component is a non-substituted amine, and whose second component is 2-8-naphthol-sulphonic acid or 2-8-naphthylamine-sulphonic acid, or a derivative of either. Three examples are given. The products range in color from yellow to red, are of exceilent fastness, and possess a very strong affinity for the fiber.

Dyeing of Acetate Silk

German Patent No. 451,231—*I. G. Farben-Ind. A.-G.*—The mtaerial is prepared with a mixture of a desired diazotizable base, a suitable second component, nitrite, soap or Turkey Red oil, etc., in a hot bath or suspension, and after squeezing is passed through an acid bath, thus developing the color. The trouble of a separate diazotizing bath is avoided. The process is an extension of the method of German Patent No. 446,541. Six examples are given.

Developed Colors on Silk-Rayon Mixtures

F. Grove-Palmer—Text. Merc. 237, 81 (1929).—A valuable paper, a continuation, from an earlier number, of highly practical nature. Included are the topics of softening of water, avoidance of blinding, selection of developers, special dyestuffs, dyeing in hank, and anaylsis of weaves of silk and artificial fiber.

Cupro-Silk, The Precipitating Bath

E. Schurz—Kunst-Seide 12,103 (1930)—The author takes up the difficulty of the breaking of fibers during spinning, and notes the cause of rupture as the generation of very fine bubbles of a gas at the perforations of the spinneret, even when gas-free (boiled-out) water is used in making up the bath. He ascribes the origin of these gas-bubbles to electro-chemical action originating in the use commonly of spinnerets whose collars are of iron and whose perforated face is of nickel, etc. These different metals form an electro-galvanic couple in the solution of which the bath is composed; hydrogen is therefore liberated upon the nickel portion. If the spinnerets are so constructed that the perforated cap is insulated from the collar, this electro-chemical action is no longer possible, and the gas-bubbles no longer form.

Flow-Relations in Fluids of Great Viscosity

O. Schrenk—Kunst-Seide 12, 96 (1930)—The earlier section of this paper has already been remarked upon in these columns. This present part, the concluding portion, is of a highly mathematical, or perhaps it might be called, formulative quality. The whole paper is written as a summary of the (higher) physical treatment of viscosity and flow.

Scrooping of Artificial Silk

Dr. W. Seck—Monatsch. f. Textile-Ind. 45, 29 (1930). The article has for its purpose the recommendation of a proprietory product, "Avivierpaste RB 99," put out by the firm of R. Bernheim, of Augsburg-Pfersee.

This scrooping, or brightening, as it would be called after dyeing, is usually the task of the finisher, strictly, that is, the dyer, if the goods are to be turned out simply dyed; or the finisher proper, if the goods are to be turned out in the finished woven condition. But many manufacturers of the raw fiber itself resort to scrooping, to give, so to say, a moral impression to the dyer or weaver. In either case, by use of the customary oily or fatty agents, the scroop is more or less lost in the very first wet treatment to which the fiber is subjected, whether bleaching, dyeing, or even only washing. The reason for this poor stability in results is due to the fact that water-soluble or easily emulsified agents have been used, in order to avoid serious trouble in the later processes which the fiber will probably have to pass through; thus, they must be capable of being easily removable, and so are easily removed. So much trouble has been caused by previous finishing, that it has become the custom to scroop or brighten the goods at the final stage, regardless of any previous treatment. The substances most used are those mentioned as water-soluble oil—, soap—, soaplike preparations, and saponified fats. It has been the idea that an oil or fat of not too high melting-point, and soft in consistency, is the best basis for such a preparation. Principally, sulphonated castor oils, and preparations based upon olive oil, have been employed. Neat's-foot oil seems to have been highly favored, and large quantities of it in various forms are today used in America.

Substances of other natures have also been tried out. Hydrocarbons, especially the hydrogenated ones, as tetraline and methyl-hexaline, and the homologues of benzene or toluene, have geen tried, but their value is at least questionable. Their scrooping effect is not really satisfactory, and they also import to the goods an odor which makes them impossible for the final finish. The recently suggested esters of adipic acid are open to the same objection. So far, only one group of substances seems to be worth considering; the castor oil group, if we decide also the semi-solid fats, such as cocoanut fat, possibly tallow, or even plain grease.

To make such substances fit to use for our purpose, each one has to be either saponified, emulsified, or semi-saponified (so that the product is really a mixture of a soap and the unsaponified fat).

Most recent experience has shown that, in this choice of fatty materials for finishing, we have been starting from completely false presuppositions. It is now recognized that the best effects are obtained, not through the very soft, fluid oil-preparations, or even through the semi-solid fats, as cocoanut fat, etc., but that reasonably hard fats produce an effect which is essentially better than anything heretofore reached. This fact shows that, to attain the desired finish, it is not increased softness to the touch, but greater luster, which is necessary: in other words, the artificial fibers, such as are on the market today, are sufficiently elastic to give the finished goods a certain softness, feel, or flexibility. What is still lacking in the artificial fibers is smoothness: that is, uniformity of surface of the single fiber, interrupted by no local unevenness. Another point of importance is, that the finishing agent shall so lubricate the surface of the separate fibers, that the latter may slip easily back and forth over each other, so that the goods gain a soft and flexible character. The hard fats impart these qualities to the fiber. Following the discovery of the valuable nature of these fats, hard paraffin emulsions have had their opportunity also. But trial of such emulsions raised the point of dangerous unsaponifiability, and of instability in the emulsified form, when soap is used as the emulsifier. If paraffin is emulsified by means of a non-fatty agent, such as one of the modern products of aromatic-organic nature, the protective colloid which becomes necessary—usually, glue, gelatine, or albumens—so affects the finishing-properties of the paraffine, that a sort of "solidification" of the fiber comes about, but no increased softness or flexibility at all, and so the purpose of the treatment is nullified.

The most recently used substances are of the group of the higher alcohols, especially those possessing 14 or even more carbon atoms, as well as the naturally-occurring wax-alcohols. It appears that the commercial product mentioned, "Avivierpaste RB 99," to whose excellent effectiveness the article leads up, is formed upon such alcohols as a base, but no hint is given as to what chemical treatment of these leads to the development of the properties desired.

Roentgen Rays in Textile Research

H. Mark—Kunst-Seide 12, 214 (1930).—An illustrated (20 cuts, most of them of Roentgenographs of various fibers) article, whose subtitles are (1) the analytical distinction between different kinds of fibers; (2) determination of the individual characteristics of different kinds of fibers; (3) the results, now available, of Roentgenographic study of the internal structure of fibers. The illustrations make the text clear, and the text explains the illustrations—necessarily so in a topic of the present sort, where visual recognition is the only means of identifying a fiber. The third section is of rather theoretical nature, dealing with the, at present, rather hypothetical views prevailing regarding the internal structure of the carbohydrate molecule. It is an interesting paper.

Adsorption with m-Cresol, Silica Gel, and A-Carbon (Recovery of Solvents)

Fritz Ohl—Kunst-Seide 12, 239 (1930).—A discussion of the methods of recovery of solvents in the artificial silk industry, with perhaps special reference to acetate-silk.

It is obvious that expensive solvents must be recovered quite completely, if a process is to continue to compete. The well-known freezing-out method is not effective; the adsorption-method, by which the solvent enters with the adsorption-agent into a combination so labile that it can be split into its components again by a reasonable heat, is the only practical method of recovery.

m-Cresol (the Bregeat process) is open to objections, because of its liability to form condensation-products (in the chemical sense) with such a solvent as acetone, whereby that part of the solvent is lost, and, still worse, the corresponding part of the cresol is resinified, or at least made less adsorptive. Tetralin, if used with it as a diluent in a moderate proportion (1-1) prevents this action to some extent. The presence of as little as 2-3% of water in the vaporized solvent strongly favors resinification. Still, the process is a good one. No protective gas (see later) is needed.

Silica gel seems to be as effective as m-cresol. The purity of the recovered solvent is higher (97-98% as compared with 75-85% for m-cresol). Disadvantages are, the large percentage of water (up to 80%) present in the recovered solvent, and the mechanical difficulties encountered in preparing and using the gel.

"A-carbon" is open to the serious objection that it strongly promotes formation of addition—or condensation—products from the solvents. But the process employing it is of great value. It seems best restricted to cases where only such solvents as ether, hydrocarbons, or carbon disulphide are in question. A protective gas (inert) has to be used with it, in order to avoid spontaneous combustion through catalytic action of the carbon upon the air-solvent mixture. Then, too, the granules of carbon gradually disintegrate, involving at least a monthly removal of the carbon-dust formed.

Of the three methods, only the first two are of practical use in the artificial silk industry.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

FIVE DYE HOUSE FOREMEN WANTED

DYE HOUSE located in Middle Atlantic State needs following men:

CHIEF EXAMINER: experience on lining fabrics essential; must have good judgment as to hand and finish and be accurate matcher.

JIG DYE FOREMAN: must have practical experience on silk or silk-mixed goods and be accurate shade matcher.

WINCH DYE FOREMAN: same qualifications as for Jig Foreman.

SKEIN DYE FOREMAN: must have experience with Smith Drum Yarn Dyeing Machines and dyeing fine yarns; experienced at accurate matching and good winding.

FINISHING FOREMAN: experienced on silk and silk-mixed goods and with ability to train help in operation of finishing equipment.

Write fully, giving details as to past experience. Address: Classified Box No. 636, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Salesman, 35 years of age, 15 years' experience, dyestuffs and allied specialties. Willing to start at small salary for probationary period. Address: Classified Box No. 634, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

As general foreman of inspection, put-up packing and shipping departments. Formerly connected with large finishing plant now liquidated. Thoroughly conversant with all grades of rayon and cotton piece goods. Best references, will locate anywhere; available immediately. Address: Classified Box No. 630, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Dyer and Tin-weighter with 25 years' successful practical experience in all lines of silk piece dyeing, conversant in dyeing of rayon, celanese and all mixed fibers, chemical education, scientific tin weighting. Best references, desires position as superintendent or manager. Will locate anywhere. Address: Classified Box No. 635, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.